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THE EFFECTS OF THE CHEMICAL TRIBUTYLTIN (TBT) ON THE MARINE ENVIRONMENT

HEARING

BEFORE THE

SUBCOMMITTEE ON
ENVIRONMENTAL PROTECTION

OF THE

COMMITTEE ON
ENVIRONMENT AND PUBLIC WORKS
UNITED STATES SENATE

ONE HUNDREDTH CONGRESS

FIRST SESSION

APRIL 29, 1987

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THE EFFECTS OF THE CHEMICAL TRIBUTYLTIN (TBT) ON THE MARINE ENVIRONMENT

WEDNESDAY, APRIL 29, 1987

U.S. Senate,
Committee on Environment and Public Works,
Subcommittee on Environmental Protection,
Washington, DC.

The Subcommittee on Environmental Protection met, pursuant to notice, at 10:00 a.m., in room SD-406, Dirksen Senate Office Building, Hon. George J. Mitchell (chairman of the subcommittee) presiding.

Present: Senators Mitchell, Lautenberg, Chafee, Stafford, Pressler, and Mikulski.

OPENING STATEMENT OF HON. GEORGE J. MITCHELL, U.S. SENATOR FROM THE STATE OF MAINE

Senator Mitchell. The hearing will come to order. Good morning, ladies and gentlemen. Good morning, Senator Trible, Senator Cohen.

Welcome to this hearing on the effects of the chemical tributyltin on the marine environment. The coastal and marine waters of our country are a natural resource of tremendous value. Marine bays and estuaries play an essential part in the ecological system which support fisheries and wildlife. Our coastal waters provide recreational opportunities for millions of Americans.

For these reasons, we must be especially alert to threats to the quality of marine waters and the integrity of the marine coastal environment. Recent scientific research indicates that a chemical added to boat paint and known as "TBT" may pose a serious threat to marine organisms and the marine environment.

The purpose of this hearing is to review the evidence of TBT effects on marine life and the beneficial uses of TBT as a paint additive. We will hear testimony on options for restricting TBT use, including regulation by the Environmental Protection Agency and legislative action by the Congress.

I am pleased that the Senators who have taken the lead in alerting the Nation to the threat to the marine environment posed by TBT are with us for today's hearing. Senators Trible and Cohen, and they and Senator Warner have succeeded in preventing fleetwide use of TBT by the U.S. Navy until the environmental effects are better understood.

I am particularly pleased to be working on this problem with the senior Senator from my home State Senator Cohen. These Senators have also introduced legislation which would restrict the use of TBT and establish civil penalties for misuse. I look forward to hearing the testimony of witnesses today on this proposed legislation and on other approaches to responding to this problem.

I and others are concerned about the evidence of high levels of TBT in the Chesapeake Bay. Recent tests by the Environmental Protection Agency indicate that TBT is present in the bay at levels significantly above the concentration levels identified by the EPA as safe. We will hear from a panel of witnesses on the seriousness and extent of TBT contamination in the bay and on the actions by area States, including Virginia and Maryland, to address the problem.

I am also concerned that TBT may pose a threat in estuaries and marine waters other than Chesapeake Bay. To date, EPA has focused much of its testing on that bay. Unfortunately, we do not have reliable data on the extent of the problem in other coastal waters, including the marine waters of Maine. A number of States, including Maine, are interested in testing for TBT, but have not been able to proceed because they lack the sophisticated equipment to identify very small amounts of the chemical. As we will hear later, TBT is toxic to marine organisms at levels as low as twenty parts per trillion.

Just yesterday I received a letter from the EPA's New England office indicating a willingness to assist the State of Maine in testing for TBT. This assistance will greatly improve our understanding of the extent of TBT contamination, and I hope the EPA will make it a general policy to assist States in this testing. The letter will be included an appropriate place in the hearing record.

There is evidence that TBT poses a threat to the marine environment and that an effective and coordinated response must be developed.

I look forward to hearing from our witnesses concerning the seriousness of this environmental threat and the best way of responding to it.

[The letter referred to follows:]

U.S. Environmental Protection Agency,
Region I,
Boston, MA, April 28, 1987.

Hon. George J. Mitchell,
U.S. Senate, Washington, DC.

Dear Senator Mitchell: Thank you for your recent inquiry concerning the extent of the use of tributyltin (TBT) in Maine waters and its effect there on marine life.

As you know, there is increasing concern surrounding this problem; EPA has several initiatives underway to study TBT including the development of a water quality criteria document and a special review under FIFRA. In addition, our Gulf Breeze Laboratory has conducted tests of TBT in Chesapeake Bay. Should the State of Maine request it, my staff would be happy to provide technical assistance and such laboratory support as possible within our Regional Office's limited resources to help determine the effect of TBT in Maine's coastal areas.

I understand that a bill, L.D. 1265, has been introduced in the Maine Legislature that would require a study on the human health and environmental hazards of TBT. The legislation would provide $50,000 to conduct a study that would have the Maine Department of Environmental Protection make a preliminary recommendation by January, 1988, on the sale and use of TBT as it is used as a dip for lobster traps; a final report is due in January of 1989. In the event that such legislation is enacted, we would look forward to working with the State to assure the success of the study.

I trust this will assist you and the Committee in your deliberations on this issue.

Sincerely,

Michael R. Deland,
Regional Administrator.

Senator Mitchell. I would like now to recognize Senator Chafee, who, for six years, was the distinguished chairman of this subcommittee and who, more than any other person in our Nation, is responsible for legislation protecting the environment and the health of the American people.

Senator, it is always a pleasure to have you here.

OPENING STATEMENT OF HON. JOHN H. CHAFEE, U.S. SENATOR FROM THE STATE OF RHODE ISLAND

Senator Chafee. Thank you very much, Mr. Chairman. I want to commend you for holding this hearing. I know that you have gone to considerable effort to arrange it, and I am fully cognizant that you have other demands on your time, as do I, in the Finance Committee, and regrettably I will not be able to stay for this hearing. But I did want to come up and say how important it is that you have this hearing. It seems to us that every few months another chemical acronym is turned into a household word. We hear about the lethal effects of DDT or PCP's, and now we have another one, TBT.

Two observations come immediately to mind when we discuss TBT. It is without doubt the most effective antifouling compound yet developed. There is no question that it does just what it advertises. It can't be matched for discouraging the attachment of barnacles, algae, and other marine organisms that hasten the decay of wood or constitute a drag on vessels. That is why it is so popular. Yet, at the same time there is growing evidence that, as you stated, Mr. Chairman, TBT is extremely toxic and is affecting nontarget marine and freshwater organisms, in other words, not just the algae and barnacles, but other organisms in our waters.

Just to give you an indication of how toxic this is, one hundred parts per trillion is the toxic effect and perhaps there is a variation from that, but 100 parts per trillion is one drop of water put into a hundred thousand tank trucks of water. Now, that is one drop of this toxic material, that is what 100 parts per trillion means.

The known effects of this toxic paint on marine organisms and human beings has us concerned, and it is already being detected in the food chain.

Cooking does not destroy or remove TBT from fish. Aside from the potential effects on human health, there are serious implications for marine habitats, and that is why Great Britain and France both are regulating TBT.

Obviously, I have a parochial interest in this, coming from Rhode Island, where Narragansett Bay is, which we consider and is generally acknowledged as one of the most magnificent bay areas in the country. This precious natural resource protects the entire spectrum of marine life, and already we have had testing of samples of Narragansett Bay water that indicate the existence, for instance, that TBT has appeared in Castle Hill Coast Guard stations, with testings taken there, of 130 parts per trillion.

As a result of my connection with the Navy as secretary for 3½ years. I fully appreciate the cost and effort required to defoul and paint large vessels. On an aircraft carrier, an overhaul and painting of the hull can run into millions of dollars. So therefore, there is a great attraction to TBT. Yet, before we know the environmental consequences of this paint, we had better pause and find out what is happening. That is why I commended Senators Cohen and Trible last year for attaching to the continuing resolution legislation which, in effect, prevents the Navy from using TBT on its ships. And given that such a ban now exists, and the additional costs of servicing the ships is being borne by the taxpayers, I would emphasize that EPA needs to proceed with all speed to evaluate the effects of this chemical.

Again, Mr. Chairman, I want to commend you for holding these hearings. You certainly are a very vigorous chairman of this subcommittee. I also want to pay tribute to our first two witnesses. You have already mentioned your distinguished colleague from Maine, Senator Cohen, with his long interest, and I also want to applaud Senator Paul Trible for his leadership. He lives, as you know, on Chesapeake Bay and knows firsthand the importance of protecting our waterways. Senator Trible has been a leader in the fight to clean up the Chesapeake Bay, not just from TBT with this legislation, but from all pollution.

Senator Trible's deep love of the bay and concern for its future led him to sponsor the legislation that I mentioned earlier prohibiting the Navy from using TBT on its ships, and the legislation we are considering here is another demonstration of Senator Trible's concern for the quality of our Nation's environment.

So, Mr. Chairman, I look forward to reviewing the testimony that will come out here today.

Senator COHEN. Mr. Chairman, if I could add, there is only one deficiency in Senator Chafee's statement. He indicated his love of and proximity to Narragansett Bay. He failed to mention he spends a considerable portion of time at Penobscot Bay when the time arrives in the summer.

Senator CHAFEE. I do. I sail the Maine waters frequently, and Frenchman's Bay, Penobscot Bay, all those areas. I want good marine life there, too. So my concern extends, and I won't limit it to the East Coast, but rather to all of our marine waters.

Thank you.

Senator MITCHELL. Thank you, Senator Chafee.

We are also pleased to have the distinguished new member of our committee who comes from a State located by the Chesapeake Bay, and she has demonstrated a real concern and leadership in that area, Senator Mikulski.

Welcome. Do you have an opening statement you wish to make?

OPENING STATEMENT OF HON. BARBARA A. MIKULSKI, U.S. SENATOR FROM THE STATE OF MARYLAND

Senator MIKULSKI. Thank you, Mr. Chairman. I would like to thank you for organizing this hearing because I think we have here a specific, immediate, realizable tool for contributing to the saving of not only the Chesapeake Bay but the other marine waters and estuaries in our country. The cleanup of our bays, whether it be the Chesapeake or the protection of the waters in Puget Sound or the coast of Maine or Narragansett is really a bipartisan, bicoastal issue. It is the kind of issue that it is a delight to work on because we know that in our States, good environment is also good business, that in my own bay, the Chesapeake Bay, it is important to our fisheries resources, our tourist industry, and to the people who live and work on the bay. We want to make sure that those opportunities still exist.

We have learned that TBT, called the most toxic substance deliberately introduced in the marine environment, threatens bay fishery resources. We want to commend the States of Maryland and Virginia for taking swift action in banning the use of TBT on boats, recognizing also the important role that Senators Warner and Trible played in ensuring that the Navy did not use TBT particularly in our water. I also would like to congratulate Senator Trible as well as Senator Cohen for their leadership, particularly for those of us on the bay who might compete for traffic. We might compete for catching crabs and rockfish also, but when it comes to cleaning up the bay, we are a team for our bay.

Thank you very much.

Senator MITCHELL. Thank you, Senator.

We are also pleased that Senator Pressler has been able to join us this morning.

Senator Pressler, did you have an opening statement you wished to make?

Senator PRESSLER. I do not, Mr. Chairman, except to congratulate you on organizing this hearing and to say that we are holding a simultaneous hearing on Superfund downstairs, and a hearing in the Foreign Relations Committee across the hall, all of which I am member, so I may be shuffling back and forth.

But I do agree with the remarks of my good friend from Maryland that good environment is good business, and I look forward to participating in this hearing.

Senator MITCHELL. Thank you very much, Senator Pressler.

I want to acknowledge a statement from Senator Warner which will be inserted at this point in the record.

[Senator Warner's statement follows:]

OPENING STATEMENT OF HON. JOHN W. WARNER, U.S. SENATOR FROM THE STATE OF VIRGINIA

Thank you, Mr. Chairman. I want to thank you and other members of the subcommittee for allowing me to participate today in the subcommittee's hearing on an issue so important to the Chesapeake Bay restoration effort.

I would like to recognize Secretary John Daniel of the Virginia Department of Natural Resources and Dr. Robert Huggett of the Virginia Institute of Marine Sciences who have taken time from their busy schedules to appear before this committee to share their views on Virginia's experience with controlling tributyltin, commonly known as TBT.

To provide immediate relief from TBT releases from this boating season while the Environmental Protection Agency continues its work, my Virginia colleague, Senator Trible has introduced legislation, which I have joined in cosponsoring, to ban the use of paints containing TBT which leach into water unacceptable levels of this chemical. I applaud him for his efforts in bringing this matter to our attention.

The use of paints containing tributyltin is an effective ingredient in eliminating fouling growth on vessels and thereby lowering operating and maintenance costs as well as fuel consumption.

However, the evidence available to me strongly suggests that TBT is highly toxic and potentially lethal to marine and freshwater organisms even at low concentrations.

The Environmental Protection Agency has also determined that TBT in excessive levels may present unreasonable risks to other aquatic organisms such as mussels, clams, oysters, and fish so abundant in the Chesapeake Bay.

These shellfish and striped bass are a major source of income for watermen and others who live off the resources of the Bay.

Therefore, it is important for us to recognize the potential threat posed by the continued use of paints which release excessive levels of TBT.

I welcome the opportunity today the hear from EPA on their continuing efforts to determine the appropriate levels of TBT in paint beyond which no significant risk to marine organisms exists.

Further, I am aware that the U.S. Navy is a cooperative partner in testing the release rates of paints on naval vessels. I am aware that the Navy has a particular need for TBT on aluminum hulled ships and I trust that we can accommodate this specific requirement.

Senator MITCHELL. Senator Trible, welcome, and we look forward to your statement.

STATEMENT OF HON. PAUL TRIBLE, U.S. SENATOR FROM THE STATE OF VIRGINIA

Senator TRIBLE. Mr. Chairman, I thank you very much. First let me extend my sincere appreciation to you and to the committee for holding this hearing and holding it early in the 100th Congress so we can shape an appropriate response.

Simply put, TBT paints are highly effective anti-fouling compounds. But they are highly toxic as well, and they pose a substantial danger to water life, to fish, to clams, to oysters, and they also may pose some threat to human health. So that is what brings us together today.

These facts have now been widely documented in scientific research and laboratory tests, and you will hear about that today. But despite this substantial body of evidence, the United States lags far behind other countries in regulating TBT paints. England, France, and Japan have all implemented limits on TBT. Germany and Switzerland have totally prohibited the use of TBT in freshwater areas. Mr. Chairman, I believe the time has come for the United States to take appropriate action to protect its environment to reduce toxic quantities of TBT.

Various laboratory studies on short- and long-term effects of TBT antifouling paints have been completed on a variety of nontarget organisms, from phytoplankton, cell plankton, or zooplankton, those being, as you well know, the microscopic plants and animals at the base of the marine food chain; and on crabs and oysters, shrimp, fish. The results from these tests on the marine environment clearly indicate that exposure of TBT concentrations of one part per trillion can cause reproductive abnormalities, serious growth problems, and death of marine life.

For example, studies have shown that the American oyster and hard clam, both common to our Atlantic coast, die upon exposure to one part per trillion of TBT and significant developmental problems are demonstrated at exposures of 770 parts per trillion.

The Pacific oyster, now beginning a comeback, is much more sensitive, it seems, to TBT, suffering larval mortality rates of 60 percent after 45 days exposure to only 240 parts per trillion TBT.

I want to underscore that many of these nontarget organisms are important links in the marine food chain. Consumers—humans, folks like us, who enjoy the bounty of marine waters—then ingest large amounts of TBT concentrations. The impact on humans of TBT at this point is largely undocumented. However, one Navy study reports that more than one-tenth of a micromolar of TBT—that is three parts per billion—can act as a membrane toxicant in human red blood cells. It alters the structure of red blood cells.

Because both marine life and public health are potentially at risk, I introduced Senate bill 428, along with my friend and distinguished colleague from Maine, Senator Cohen, and my colleague and friend from Virginia, Senator Warner. Our legislation would suspend the use of all marine paints that release large concentrations of the highly toxic TBT compounds until EPA determines that these paints do not pose an unacceptable hazard to our marine environment.

This, as you pointed out, extends the effort that we began by preventing the Navy from painting its fleet with these TBT compounds.

As you are aware, EPA is now conducting a review. That process is necessarily a lengthy one, and it could take years to complete. That is why we must act now to protect our environment on an interim basis.

Let me bring to the committee's attention some differences in emphasis as we go about tackling this problem. Our bill sets as a maximum standard a steady-state release rate of 0.5 plus or minus 20 percent micrograms per square centimeter per day. That is a mouthful. This figure derives, Mr. Chairman, from a Navy test methodology. A more common standard is that employed by EPA of 5.0 micrograms per square centimeter per day, which is essentially the same release rate expressed in terms of a different method.

I am not wedded to any specific release rate value. Rather, my goal and the goal of my colleagues is to assure the health of our waters, and it is up to you and the experts to agree on an appropriate standard. But let's find the appropriate standard beyond which we should not go and ensure that those paints that contain a highly toxic concentration of TBT cannot be used and will no longer endanger our marine environment.

A second difference in approach is the issue of vessel size. The Virginia Legislature has recently banned the use of TBT on recreational vessels less than 25 meters in length. That is about 82 feet. Our bill bans the use of TBT paints that exceed the appropriate standard on all vessels. Quite candidly, I thought it was best to err on the side of caution. But again, this is a question for this committee to pursue.

In summary, Mr. Chairman, I believe that given what we know about the adverse impact of TBT compounds on water life, on human life, that inaction is unacceptable. Therefore, I would urge this committee to take appropriate action and immediately reduce the amount of TBT that finds its way into our Nation's waters, to provide a safer environment for water life and for people.

Once again, I know how busy you are, Mr. Chairman. You and I are partners in the Iranian arms investigation and serve on the Finance Committee. I thank you for taking time and honoring the promise of Senator Chafee in the last Congress last year that he would hold hearings early in this year. I applaud your leadership. I look forward to working with you and Senator Mikulski, my partner and friend on the Chesapeake Bay from Maryland, and other members of this committee in fashioning an appropriate response. It is important that we move forward decisively and thoughtfully to a matter that poses a great risk to our environment.

Senator MITCHELL. Thank you very much, Senator Trible.

Senator Stafford, do you have an opening statement you wish to make?

Senator STAFFORD. No, Mr. Chairman, I do not. But I am very much interested in the testimony this morning, so I made it a point to get here after another meeting.

Senator MITCHELL. Well, you came at just the right time because we are just about to hear from our distinguished senior colleague, Senator Cohen.

Welcome, Senator.

STATEMENT OF HON. WILLIAM S. COHEN, U.S. SENATOR FROM THE STATE OF MAINE

Senator COHEN. Thank you very much, Mr. Chairman. I will try to be brief and avoid, as much as possible, being redundant, which is hard to do in this particular institution.

I became involved in this issue two years ago during the debate on the continuing resolution. At that time it was raised by Senator Trible and Senator Warner as an issue. During the course of that debate, I took pains to point out that in proposing the amendment, we were not in any way specifically aiming our attack at the Navy. We were not accusing the Navy of any wrongdoing.

On the contrary, we pointed out that the Navy has met all Environmental Protection Agency regulations. Its paint specifications are far more stringent in terms of toxicity and release rates then those used in the recreational or commercial industry. The Navy has been in the forefront of ongoing efforts to reduce the toxic content of organotin-bearing antifouling paints. It has researched the matter far more extensively than any segment of the maritime industry.

Mr. Chairman, our concerns must of necessity, be focused on the potentially harmful effects that the highly toxic pesticides of the organotin family of compounds may have on our marine life and public health. We are all familiar with Rachel Carson's "Silent Spring." Perhaps we could term this "Our Toxic Seas." As Senator Chafee pointed out, and he is a former Secretary of the Navy, this is a very effective compound. It does exactly what it purports to do, and it saves us money. The Navy points out, for example, that the use of TBT probably reduces the consumption of fuel by about $150 million per year, and saves another $5 million in maintenance costs.

We are talking about substantial energy savings. The more efficient the paint, the more efficient the ship is moving through the water, the less drag, the more fuel that is saved. But that is precisely the question that has to be raised: what price energy conservation in this case if we are in fact poisoning the very marine life that so many of the States depend upon? Officials in Maine, New York, New Jersey, Maryland, Virginia, North Carolina, Florida, California, Washington, and Oregon have all raised very serious concerns about what this is doing to marine life.

I think Senator Trible mentioned how France has responded to the TBT threat. In 1982 the French banned the use of TBT on boats under twenty-five meters—I had to have this translated—which is eighty feet in length. French scientists noted that oysters in and around the boat moorings in marinas experienced abnormal shell growth, reduced reproduction rates, and mutations in oyster larvae. Evidence of these abnormalities was no longer present following the prohibition of TBT.

In 1985, William Waldegrave, England's junior environmental minister, stated that—and I am quoting now—he had "seldom been faced with clearer scientific evidence of the need for environmental action—and fast; that the apparent tendency of organotin-bearing paints to stunt the growth of Britain's Pacific oyster is just the visible tip of a potentially massive environmental iceberg." England is now regulating TBT, and Canada, Japan, West Germany, Switzerland have all acted to limit its use in freshwater areas. Mr. Chairman, the growing environmental threat posed by TBT demands an urgent response from Congress. That is the reason these hearings are so important and why I hope you will take the testimony of the experts in the field to determine what is the proper course of action to follow. I commend you for holding the hearings, and I hope the Committee will act expeditiously.

Senator **Mitchell**. Thank you very much, Senator, for your very informative statement.

Senator Mikulski, do you have any questions of either Senators Trible or Cohen?

Senator **Mikulski**. No. I have no questions, Mr. Chairman.

Senator **Mitchell**. All right.

Senator Stafford?

Senator **Stafford**. I have no questions, Mr. Chairman.

Senator **Mitchell**. All right.

Well, thank you both, Senators. In view of your interest in this issue, you are welcome to come up and participate in the remainder of the hearing if your busy schedules permit.

Senator **Cohen**. I would like to, Mr. Chairman, but I have a markup at this time.

Senator **Mitchell**. All right. Thank you, Senator.

Senator **Trible**. Thank you, Mr. Chairman. I will join you.

Senator **Mitchell**. All right.

Senator **Trible**. Thank you.

Senator **Mitchell**. The next witness will be Dr. John Moore, assistant administrator for pesticides and toxic substances, Environmental Protection Agency.

Dr. Moore, welcome. We thank you very much for coming today. We look forward, as always, to your testimony.

STATEMENT OF JOHN A. MOORE, ASSISTANT ADMINISTRATOR FOR PESTICIDES AND TOXIC SUBSTANCES, ENVIRONMENTAL PROTECTION AGENCY

Mr. MOORE. Senator, with your permission, I would just like to highlight from my testimony and ask that the full statement be inserted for the record.

Senator MITCHELL. Go right ahead.

Mr. MOORE. Thank you. As I think you know, Senator, EPA is required under the Federal Insecticide, Fungicide, and Rodenticide Act to balance risks and benefits in reaching regulatory decisions involving the use of pesticides. We typically do this through what we refer to as our special review process, which we think allows one to have an open and responsive mechanism whereby everybody has a chance to participate.

In January of last year we did trigger this process as it relates to all pesticides containing tributyltin compounds used as additives to antifouling paint. As you heard and well know, these paints are applied mainly to boats and ship hulls to inhibit the growth of certain aquatic organisms. Use of these compounds in any antifouling paints may result in significant exposure to nontarget aquatic organisms in concentrations resulting in acute and chronic toxicity. There is no question that tributyltin compounds have been found to be toxic even at very low levels, in some instances down at the part-per-trillion range, to some of these nontarget organisms. The sensitive species, or the most sensitive species, appear to be in the phyllum mollusca, which includes the snails, the clams, the mussels, and the like.

In initiating the special review, the agency identified gaps in data that it thinks it would benefit by having in hand in order to reach a final informed decision. In July of last year we levied these data requirements pursuant to our authority under the act on registrants. One of those requirements is the release rate test, which under laboratory conditions measures the rate at which tributyltin is released from a painted surface such as a boat hull after immersion in water.

A protocol for this test was developed by the agency in cooperation with the American Society for Testing and Materials. The results from these tests are now coming in and are under review, and I think will clearly assist us in determining daily release rates and six week cumulative release rates for different paint products that are on the market.

Based, however, on the rate of compliance so far with this data call-in, it appears that a significant portion of registrants are unwilling to bear the cost for the required testing. For example, as highlighted in my testimony in greater detail, twenty registrants involving eighty-two paint formulations voluntarily requested cancellation of their product. Significantly, the total number of products voluntarily cancelled are subject to notice of intent to suspend on the part of the agency because they did not commit. The total is about three hundred formulations, or about eighty percent of the three hundred fifty-nine tributyltin-containing products. That number represents roughly one-half of the annual volume of production of tributyltin.

Obviously, one can predict that those that are left on the market, I think, will increase their market share. I don't want to suggest that this is indeed a final change.

The agency has also, in addition to this type of leach rate information, required information on product chemistry, ecological effects, environmental fate, worker exposure, quantitative usage, and efficacy of products. Some of these data requirements can be generated in a relatively short period of time. Other parts of these data sets may take two to four years to complete.

There is no question that the adverse consequences that is receiving focus by us and others is primarily death as an outcome, a rather dramatic, final type of outcome. At some stage of, say, a mollusk's life cycle.

There are also significant questions, I think, concerning the sublethal effects of tributyltin exposure on the reproductive and growth of these nontarget organisms, and these issues will be only understood after we have some of these long-term studies in hand.

In addition to getting this information, we have also been collecting information and reviewing information dealing with water sampling. The agency has studied environmental levels of tributyltin by taking samples in the Chesapeake Bay. Jim Seif, in his testimony to be presented later today, will discuss the results of some of these samples that were taken last year. Other analyses have also been done by the States of Virginia, Maryland, and California in order to determine levels in their surface water ecosystems. In addition, the Navy has sampled waterways for tributyltin in many locations throughout the United States.

All of these data are currently being evaluated to see if we can make greater sense about the totality of the information beyond any specific sample result. Rather than wait until all of the data is at hand before taking some type of regulatory action, I continue to envision a two-phase regulatory process. Based on the water-sampling activities and the information obtained from the release rate test data, we hope to be in a position to take a preliminary regulatory action this fall. It may be inappropriate to speculate in any detail as to what the nature of that action is going to be, since we are still reviewing and are still to receive some of the data that I think is pertinent to such an evaluation. Measures that most likely are going to receive strong consideration will include the initiation of actions to restrict or cancel the registrations of antifouling paints, based on release rate or other criteria, as appropriate. Concurrently, we might also as a condition of continued registration, require intensive monitoring of tributyltin concentrations in what appear to be most vulnerable areas of the environment.

The long-term ecological effects and environmental fate data will become available over the next four years. I think the agency then would be in a position to define its interim posture, that I have referred to, that we might be able to make later this year.

Complementing the actions of our own Office of Pesticides Program, the agency's Office of Water is also developing water quality criteria with regard to tributyltin. This is done under section 304 of the Clean Water Act. The Office of Water is initiating the development of a water quality advisory. The advisory is designed to be low-cost, more efficient to compile and analyze existing data available to the Agency and to provide such information to the States more quickly than is possible through the criteria development process. Advisories obviously can be updated much more quickly than criteria documents can be.

The Office of Water has decided to delay the issuance of its proposed criteria document until such additional data can be analyzed. Were a standard to be issued, however, the criteria recommendations which would be put forth are in the order of, in freshwater, 20 nanograms per liter on a continuous quantity basis with a peak exposure of 150. Similar numbers in saltwater would be 30 and 240 nanograms per liter.

The Office of Water expects to issue its available information on tributyltin in the form of this water quality advisory within the next ninety days.

With respect to legislation, we feel that there is no call for additional legislation such as that provided in the proposed Tributyltin Antifouling Paint Control Act of 1987. Our ability to act has been constrained not by insufficient statutory authority but by the lack of adequate data necessary for making scientifically sound decisions. The proposed legislation mandates the use of a steady-state release rate as the sole regulatory criteria. We feel that there currently is no rational basis for choosing this one approach from amongst various possible regulatory criteria, let alone determining the specifically relevant release rate value.

Also, the bill raises some potential legal issues within the agency as it relates to FIFRA section 6 suspension authority and to whether or not there might be some implications to the agency under the indemnification and disposal requirements in other parts of the statute.

I think in a more fundamental nature, Senator, we strongly oppose the general principle of the use of chemical-specific legislation to supersede the regulatory process previously established by Congress to treat with these types of issues. The issues that are involved are typically of a highly technical nature and as such are often not amenable to resolution by a legislative process.

If I could summarize where I think we are, there is no question that tributyltin is toxic to nontarget organisms, particularly mollusks. We know that there are concentrations in water. These concentrations are variable depending upon where you sample. Hotspots do exist. I think Jim Seif's testimony later this morning will identify that.

The levels that may be found are going to be highly dependent upon climate and the flow of water that is going into any particular location. We do have leach rate data. We are seeking such data and in fact have found, in the process of demanding such data, a significant number of registrants are leaving the market. While I have no data to back up what I am going to say, I think it is reasonable to conclude that the number of registrants who have elected not to commit to the investment may well recognize that indeed some of the formulations are these high-leaching formulations and have elected to withdraw from the market.

I think we can take an interim action and we hope to do it later this year. We need to identify on an interim basis that concentration in water that we want to stay below. And indeed the numbers that I quoted in that EPA advisory I think are in the general range of numbers that we are probably going to look at at least as a start.

We have got to correlate that target number with leach rates. What leach rates do we want to control, or to allow, to keep us below the number that is causing the adverse effect. I think that is the challenge we have in the next few months in order to come up with what our interim posture is going to be; and then in the longer term, when we have these more sophisticated data dealing with maybe subtoxic types of effects, maybe revisit that number and refine it, as appropriate.

I would be glad to answer any questions you may have.

Senator **Mitchell**. Well, thank you very much, Dr. Moore.

In your written statement you express your opposition to any further legislation. I assume that you are referring to the bill introduced by Senators Trible and Cohen.

Let me ask you about your authority under current law, which I understand to be special review under the pesticide law and the setting of water quality criteria under the Clean Water Act.

As you note in your statement, your authority under FIFRA is tied to economics and the benefit of a product. Water quality criteria, as you note, do not reflect consideration of economic or technological feasibility. Does this create a problem in reconciling different authorities? Might you not get to the point where you establish a release rate for TBT in paint that makes sense under the pesticide law, considering the benefits of the paint and the statutory standard under which you must make decisions under that law, but still release so much TBT that water quality criteria are exceeded and fish and shellfish die?

Mr. **Moore**. Senator, I think any time you have a law such as the pesticide statute, which acknowledges that you may accept some degree of risk for the benefits derived from use, and compare it to some other statutory requirements and other laws that deal with something that just focuses purely on a biological effect or preventing a biological effect, you could appear to be in conflict.

I think what the issue that it is probably going to come down to is, is it conceivable that in the final decision under FIFRA, one might decide that in certain locations you will accept some degree of jeopardy to certain forms of aquatic organisms, in this case, such as in marinas, particularly where the levels are going to be very high because the number of hulls that are found there, in order to gain the benefit that is associated with the painting of that hull.

I think the thing that we would look at very closely under FIFRA is to make sure that indeed—let's assume that we continue to believe that mollusks are the highest-risk biota that are out there—that indeed we don't cause circumstances in reproduction in areas like that that I think cause broad effects.

Shortly said, one might accept some degree of loss in Annapolis yacht basin, for example, and certainly not tolerate similar levels in the majority of the other places of the Chesapeake, using the Chesapeake as one example.

Senator **Mitchell**. In your testimony you state that EPA has conducted tests for TBT in the Chesapeake Bay and some other areas and that tests have been done by States and by the Navy. Taking all of the tests together, how widespread would you say the problem is? Should we be concerned with more than just Chesapeake Bay?

Mr. MOORE. Oh, I think so. I think there is data that clearly shows that the Chesapeake Bay is a problem. It might be a focus of our attention because of the sampling that is going on there. But there is no question that some of the West Coast harborages have also been shown by some of the sampling that the Navy did, for example, out in the San Diego area, to have significant levels. I am sure if we look intently enough in Puget Sound or even at the Great Lakes, we will find some areas where TBT is present.

I don't think the question is whether or not you're going to find the presence of TBT materials in these various bodies of water. It is at what concentrations. Then I think the challenge to this agency is can you control the use and the release of these materials to allow the benefit to be derived, but yet do it in such a way that you don't cause some type of Draconian consequence to the environment in the process of doing so.

Senator MITCHELL. Does EPA need additional resources to deal with this problem?

Mr. MOORE. The Agency always needs additional resources to do what it would like to do, and particularly on the timelines that some people might like to have something done on a particular issue. I think that we are moving forward in a studied fashion. I think what additional resources may well do would be to allow us to accrue what information we needed, to some degree, in a faster time frame and therefore maybe accelerate the decision-making process.

Senator MITCHELL. I understand TBT is sold in products other than paint, such as to keep marine growth off of crab traps and lobster traps and fish netting. Does your special review of TBT cover these uses other than paint?

Mr. MOORE. Senator, our special review was focusing on TBT as a paint on hulls. We are aware of these other uses in dipping lobster pots or some of the net uses and things like that, as well as some of the uses in chilling towers and materials like that.

Senator MITCHELL. You say you are aware of it. Are those included as part of your special review?

Mr. MOORE. Yes. The Special Review includes all pesticide products containing tributyltin (TBT) active ingredients used as paint additives (antifovlants) to inhibit the growth of certain aquatic organisms. While the primary focus of the Special Review has been on the boat hull uses, other miscellaneous uses (e.g., crab pots) are included.

Senator MITCHELL. Do you have authority to regulate these other uses?

Mr. MOORE. Yes.

Senator MITCHELL. Thank you. I see my time is up.

We will proceed with questioning in accordance with the committee rules. The questioning will be by the Senators in the order that they appeared at the hearing and will be limited to five minutes each round until all Senators have completed their questioning.

Senator Mikulski?

Senator MIKULSKI. Mr. Moore, my questions will really be related to the expedition of regulation. As you know, Maryland and Virginia have acted in a coordinated way to deal with TBT in their own Chesapeake Bay. What you are saying is that you would like this to be dealt with not as a single toxic in a particular piece of legislation but be included in your overall regulatory process. Am I correct in the gist of that?

Mr. MOORE. Yes.

Senator MIKULSKI. My question to you, sir, is that EPA regulations always seem to take longer than expected, and that concerns us. We would like to see this fast-tracked so that we have the scientific data, we have the proper assessments, in order to achieve the proper balance between risk and cost benefit.

The public and the industry and, quite frankly, myself are skeptical of EPA when it says, "Just leave us alone and we will take care of it." Could you comment? If we in a sense followed your recommendation, when could we expect the regulatory process to be concluded?

Mr. MOORE. Senator, in part, my response is going to be philosophic in nature, but I think it's important. That is, in the instance that we are discussing this morning, as you point out, the process often takes longer than EPA or a regulatory agency states it will despite maybe its best intent. So as a result, there is a feeling that indeed the issue was of such importance that indeed we shouldn't wait the traditional time frames.

I would submit that some of the reasons under the pesticide statute, for example, that it seems to take so long to achieve the ultimate decision that the agency might come up with is embodied and inherent in the way the statute is drafted. I would much prefer that if you are frustrated with the pace by which we can do something such as TBT, address the root problem, and that is, take out some of the administrative impediments that are in the statute. Then I might be able to move faster rather than try to bandaid the fix with TBT in this case.

Senator MIKULSKI. So you say we have given you too much to do?

Mr. MOORE. No. I am saying that the statute that you have assigned to me to carry out my work sometimes is not associated with a fast pace, and that indeed if you want me to move at a faster pace, one can make some changes in that statute. I will give you an example. The special review process in a way is similar to informal notice and comment rulemaking. We state a concern, draw comments, then propose an action, draw comments, then go final with what we think is the proper solution. If somebody takes exception to that proper solution after all the notice and comment, they can ask for an administrative hearing. That administrative hearing then ignores everything we've done up to date and we start all over. It's almost like we never did anything.

Those hearings sometimes take two to three years. After that, if you still don't like what the agency is proposing to do, you can then resort to the traditional court mechanism. I am not sure that that system that I have outlined is responsive to a concern like TBT that you are outlining. We could drag on, even if we proposed an action this fall, we could drag on several years before we would ever get there because of the processes that are established in the law that are available to registrants or other interested parties.

I am off on a different subject. I apologize.

Senator **Mikulski**. If we asked you then to proceed under the framework that you would like, how long would it take you to come up with the kind of conclusions you need for TBT?

Mr. **Moore**. I would hope that we could identify interim measures this fall, propose them, probably go final with them late winter, since we have got to wait for comment period there before we could go final. Assuming that somebody did not ask for an administrative process—and I obviously can't predict that; it's in the private sector—I think we would be over an interim basis. I think the long-term solution is not statutory-dependent, it's data-dependent. It just takes two to four years to get some of these multigenerational types of data in dealing with low levels of TBT which is not available to any of us right now.

Senator **Mikulski**. Thank you.

Mr. Chairman, I have no further questions.

Senator **Mitchell**. Thank you very much, Senator Mikulski.

Senator Stafford?

Senator **Stafford**. Thank you, Mr. Chairman.

I thought I knew something about marine matters, but I must confess now I don't know much about TBT. I notice that on page 8 of your statement you said that you were surveying private boatyards. I presume by that you mean the marinas on Chesapeake Bay, for example, and probably up through the New England coast and up off the coast of Maine. Am I correct in that assumption?

Mr. **Moore**. Yes. I think, Senator, what we are trying to get there in the survey is to get a sense of exactly what these boatyards are using and how they are using it.

Senator **Stafford**. I also notice that in the statement of Mr. Torrey Brown, for Maryland, that one of the marinas where TBT sampling has been occurring happens to be the Hartge marina in Galesville, Maryland. I suppose I should direct any question about that to that witness when the time comes. But I gather that TBT is used as an ingredient in bottom paints for wooden-hulled small boats as well as large ships both aluminum and steel construction. Am I correct in that?

Mr. **Moore**. That's correct, Senator.

Senator **Stafford**. I will say at this point, I have simply learned something about bottom paints I didn't know, and I will reserve my questions, Mr. Chairman, until some of the other witnesses have a chance to come forward.

Senator **Mitchell**. Thank you very much, Senator Stafford.

Senator Trible?

Senator **Trible**. Dr. Moore, would your suggested release rate protect water quality, or does your release rate only represent the lowest release rate in commercially available TBT paints contain?

Mr. **Moore**. Senator, I missed the very beginning of your question. Could you restate it?

Senator **Trible**. You have indicated that you are moving forward in this process and you are going to come forward with a standard, an interim standard. Does that release rate that you are moving toward determining, is that going to be a standard that protects water quality, or does that release rate represent the lowest release rate that commercially available TBT paints can achieve?

Mr. Moore. Well, I think it is two different things. If it's under the advisory that is part of the implementation of the Clean Water Act, it's primarily going to be based on data they have in hand, and in this case probably controlling for minimization of environmental effects. Effects on biota I think, are seen at lower dose levels than effects on man. So that the environmental data would, I think, drive.

If the pesticide program was to elect to move forward, the standard it would be talking about, it would set a number, and I am suggesting that the number we would look at is probably around the numbers that I have stated in my testimony. We then would translate that number into leach rates: what leach rate is permissible; what is the maximum leach rate one might say is permissible to keep one below that number, particularly in the broad areas of water?

It's not to say that one might not in the final analysis decide that you will tolerate a level at or right around that in certain restricted certain areas such as marinas or something like that, acknowledging that you will accept some degree of adverse consequence to biota.

Senator Trible. Right. Now let's try to express that in terms that most people can understand. Are you saying that when you take this interim step sometime in the future, perhaps in the fall, that you are going to establish a standard which says, in effect, that if you go beyond this standard, it is adverse to the environment, but that some TBT concentrations are acceptable, pose an acceptable hazard and they are the ones that fall within that standard? Is that what you are endeavoring to do?

Mr. Moore. Senator, on an interim basis we are going to try to act on the information we have which we think is adequate to make some kind of tentative or temporary but informed judgment. In essence, I think what we would try to do is to say, since the pesticide law is a licensing statute, we basically are going to say that in order for you to continue your license or to get a license if you are looking for a new product, you have to submit data to us that shows that your material is not going to leach greater than a certain rate. We might also combine with that a concentration of tributyltin in your paint formulation also cannot exceed some level. It could be a correlation of that.

We also could put in something that dealt with hull length. I can't be precise as to which one, but it would be those types of things.

Senator Trible. All right. So what you are endeavoring to do is precisely what we endeavor to do in this legislation, and that is balance the economic benefits of TBT paints against the adverse impact on the environment in trying to find a standard that separates the two. Is that right?

Mr. Moore. That's right, Senator.

Senator Trible. All right. Now, let me ask you, your agency now has been focusing on TBT paints for a couple of years, and I appreciate that attention and expenditure of energy and talent and time. I guess what troubles those of us on the Chesapeake and our colleagues that are focusing on the problems presented by TBT is how quickly can we act.

Obviously, we want to act thoughtfully. But the preliminary evidence is that TBT paints pose a considerable risk to the environment. So let me ask you to focus once again on this interim step that you propose. The timing. In your statement you said EPA will be in a position to make a preliminary regulatory decision by fall. In a follow-on statement you were less certain. You said, "We hope to take action this year." That troubles me. And I understand the difficulty of making a certain statement. But please understand our impatience and our sense that we must act now to protect the environment.

Focus, if you will, on the timing, and also lay out for me, if you will, what delays might occur thereafter. Is there an appeal process? Is there a regulatory process that might ensue? How long might this go?

Mr. MOORE. OK. Senator, though, let's assume that we meet that target and indeed we announce our proposed action in the fall, let's say, September, the first month in the fall. By statute, once we have done that, we must receive public comments on the wisdom or the lack thereof of whatever it is we are proposing.

We also must formally solicit comments from the U.S. Department of Agriculture as well as the scientific advisory panel which is mandated under that statute.

Senator TRIBLE. How long a period is that?

Mr. MOORE. Typically, we must give USDA, my recollection is, thirty days. I think they could ask for sixty days, in that time frame, for their comment. We then have to take those comments and come up with a final judgment. I would predict, in good circumstances, if we weren't inundated with comments or found a comment that was particularly problematic because we hadn't thought of something or whatever the case may be, one could turn that around and maybe come out in late winter, March, with a final decision. This is what it is the agency proposes to do. We typically would do that if we were proposing to change.

We would say registrants had to agree with the following changes, and if they don't, we *will* cancel their product. They would have thirty days to object to that. If they object to it, the traditional way they would object is to say, "Hey, we think your decision is flawed. We want to ask for an administrative hearing." They ask for it, they're going to get it, and that process typically take a year to two years to three years on up. I can't control that process.

I would also be very candid with you in saying that in my experience with EPA, now some three and a half years, there has not been an action that I have taken that is suggesting some type of restriction or cancellation of any product without somebody somewhere at some time asking for an administrative hearing.

Senator TRIBLE. I understand. If I could just conclude this line of questioning.

Senator MITCHELL. Senator, in view of your interest and leadership in this area, unless the other members object, I propose to defer to you to go ahead and take another round of questioning so you can complete your train of thought.

Senator TRIBLE. Thank you, Mr. Chairman. You are very generous.

Mr. **Moore**. Senator, may I add just one thing to my comment, which I think is what you are trying to get at. That is, if somebody asks for an administrative hearing, the product stays on the market during the pendency of that hearing. It's not that the product is off the market and then we'll argue about it. It stays on the market until that hearing is concluded.

Senator **Trible**. That's what troubles me, Dr. Moore. That's what troubles me.

Mr. **Moore**. It troubles me as well.

Senator **Trible**. I understand that. We have established the ground rules under which you must operate. So we accept full responsibility for that. And I can understand your frustrations. But I wanted you to spell out in your testimony—and you have done so now in considerable detail—the delay that will ensue inevitably in this process. Senator Mikulski pointed to this in her earlier round of questions. But your testimony suggests decisive action in early fall. In truth, even if you are able to render that interim proposal, the process will take months and possibly years to unfold, and so there will be no relief in the near term, and TBT paints will continue to pose a substantial hazard to our environment, and I guess that's why we're here today, Mr. Chairman.

I wish you well, and I applaud your good efforts thus far, and I just want to see this process expedited. And I thank you.

Thank you, Mr. Chairman.

Senator **Mitchell**. Thank you, Senator Trible.

Dr. Moore, much of your work on TBT has addressed the question of a release rate from the paint on a boat. I gather that you are considering some action to restrict release rates. Are you considering the possibility that if the use of TBT in paint with a specified release rate is then seen as safe, that the substance will be used in much greater total quantities and therefore pose an even larger threat than is now the case to the environment?

Mr. **Moore**. Senator, I think the reason we have focused on the "release rate" early on is that it seemed to be an avenue that might allow a quick interim solution to the major part of the problem, particularly in the knowledge that indeed paint formulations basically have TBT in it under two general sets of circumstances. One is a free association: you just add it to the paint and mix it. The other one is that in the formulation of the paint, you basically have got it in a copolymer type of formulation.

The feeling early on was that indeed it was probably these free-associated paints which were the ones which leached at much greater rates and indeed if you could do something about those, you might eliminate a lot of the immediacy of the issue.

The data that we are getting back, however, which is in review right now is suggesting that it's not just that simple. In fact, the paint with the lowest leach rate that we have thus far on the forty-some-odd samples that we've received happens to be a free-associated paint, pointing out that the world is not going to segregate itself so easily.

Senator **Mitchell**. Yes.

Mr. **Moore**. This is where I think we are going to try to focus on, not the type of formulation but say we'll leave the formulation up to somebody else and I am just going to base it on what happens once it's on a piece of material: will it stay there? If it stayed there, we probably wouldn't be having this hearing because it wouldn't be causing problems to the other biota. So we're going to try to focus on how can we minimize the rate of leaching from that material released into the biota. Hopefully, we can set a number.

One of the problems as I sit here today is I don't know what the number is. I think I have a general idea of what number I want to stay below in water to protect the biota. I have now got to make that transfer between what that number is, the number of ships, the number of hulls, the surface area, the type of climate that is involved, and translate that into what would that leach rate might be off the hull of a ship if we applied it to make sure we stayed below that. That varies from East Coast to West Coast, for example.

Senator MITCHELL. Yes. Well, another point I want to make is that one of the deficiencies of the legislative process is that we frequently enact laws assuming static behavior after the change. In fact, of course, a law can influence behavior and you have to try to assess the implications of that changed behavior, and I merely urge you to do that.

I just have one final question. I understand that another product like TBT called triphenyltin may be just as toxic to marine life and is already being used in some boat paints. Are you aware of that product—or products, I guess; they include more than one.

Mr. MOORE. Yes.

Senator MITCHELL. Are they covered under your special review?

Mr. MOORE. Senator, we are aware of triphenyltins as well as tributyltins. The initial data call-in activity did not involve triphenyltins because we weren't sure they were found in antifouling paints. We subsequently have laid on a requirement of triphenyltin similar to that which we have on tributyltin.

The other thing we are aware of is that I think every instance where triphenyltin is being used, it is also being used with the tributyltin formulation. So we are not ignoring that issue.

Senator MITCHELL. Thank you.

Senator Mikulski, do you have any further questions?

Senator MIKULSKI. No. I think Senator Trible asked them.

Senator MITCHELL. Thank you.

Senator Stafford, do you have any further questions?

Senator STAFFORD. Just very briefly.

Dr. Moore, I note in skipping ahead to some of the other statements, that Maryland and Virginia have already adopted legislation in which they attempt to control TBT's in paint in the Chesapeake Bay. Have any other States, to your knowledge, moved ahead on their own?

Mr. MOORE. To my knowledge, North Carolina. I am told that North Carolina has done something. I don't remember what exact remedy they had. I also am told that the State of California has announced it is going to start giving priority attention to the issue.

Senator STAFFORD. Thank you.

Thank you, Mr. Chairman.

Senator TRIBLE. Mr. Chairman, may I just add that there are a number of States in which bills are now pending before their legislatures. They include Oregon, Washington, Alaska, California, and, of course, action has been taken in Virginia and in Maryland. So there is a good deal of activity at the State level. Again, people understand the immediacy of this problem, and they are trying to fashion an interim response, awaiting the judgment of the experts and the gathering of the evidence. It takes, regrettably, a long time.

Senator MITCHELL. Dr. Moore, thank you very much for your testimony. We look forward to working with you in this area.

Mr. MOORE. Thank you, sir.

Senator MITCHELL. The next panel includes Dr. Arthur Sheldon, the director of safety and environmental affairs, at M&T Chemicals, Inc.; and Dr. Robert Huggett, the Virginia Institute of Marine Science at the College of William and Mary.

Welcome, and thank you for coming. I would like to inform you and subsequent witnesses of the committee's rules regarding testimony which apply to all witnesses other than Senators and spokesmen for the Administration. Your written statement will be inserted in the record in its full text. We ask, because the time of the Senators is limited and there are several other witnesses, that you confine your oral remarks to a five-minute summary, hitting the highlights of your testimony, and then you will of course be subject to questioning by the Senators here. Thank you very much.

Mr. Sheldon, we will begin with you. You are the first listed on the witness agenda. Welcome, and we look forward to hearing from you.

STATEMENT OF ARTHUR SHELDON, DIRECTOR, SAFETY AND ENVIRONMENTAL AFFAIRS, M&T CHEMICALS, INC.

Mr. SHELDON. Thank you, Mr. Chairman. Mr. Chairman and members of the committee, my name is Arthur Sheldon. I am the Director of Safety and Environmental Affairs for M&T Chemicals, Inc., where I have been employed for more than thirty years. I would like to thank you and the committee for the opportunity to present this testimony on Senate bill S. 248.

M&T is a major manufacturer of many organotin-based products, including tributyltin compounds for antifouling paints. Over the past twenty-five to thirty years, M&T has conducted numerous studies with these chemicals to better understand their potential effect upon man and his environment. To date, there is no evidence that organotins are carcinogenic, mutagenic, teratagenic, or cause reproductive health effects. Unlike other organic compounds which are persistent in humans and in the environment for many years, tributyltins undergo rapid decay or degradation. Tributyltins quickly degrade to dibutyltins, then more slowly to monobutyltins. The final degradation step is to inorganic tin, which is identified by the Food and Drug Administration as generally recognized as safe.

Each step in this decay process results in a less toxic species. The rates of degradation differ somewhat between humans and the environment. The end point, however, is the same in each case—the compound decays to a less toxic species.

From our experience with the production and use of tributyltin compounds, we have learned that the acute health effects resulting from exposures are limited to skin, eye, and possibly mucous membrane irritation, with no reports of chronic adverse health effects. No long-term medical problems have been detected in the work force that could be attributed to repeated low-level exposures of tributyltin compounds.

In humans, the decay rate of tributyltin compounds is less than one week. This information is based on a recent accident in which a woman swallowed a quantity of tributyltin oxide.

In the environment, the degradation pattern of organotins occurs in the same manner as in humans. Field studies have shown that the half-life in water ranges from six to nineteen days. As with humans, the toxicity to aquatic organisms of the di- and monobutyltins is far less than the tributyltin compounds.

Aquatic laboratory studies generated by M&T and reported in the literature show that tributyltin antifouling compounds are toxic. This is an expected response for a biologically active chemical. Although laboratory experiments are of value in determining the range of toxicity for a chemical, they do not address the question of their potential toxic effect in a true ecosystem. They do not reflect the many complex interactions present in the environment, including decay or degradation.

For these reasons, it is extremely difficult to use only laboratory data to predict the effect on inland waters. Six years ago, before there were any concerns raised about the use of these chemicals, M&T decided to study the potential effects resulting from possible extensive and increasing use of organotins in antifouling paints. We performed a mathematical modeling study based on New York Harbor and Chesapeake Bay. In the course of these studies, we assumed that 100 percent of the vessels in these harbors would be coated with tributyltin-containing antifouling paints. The model took into account all available data. The study concluded that there would not be an adverse effect on marine life if all the ships in either New York Harbor or Chesapeake Bay used organotin paints.

I would like to show you an enlargement of the photograph of a panel that has been coated with a copolymer tributyltin compound. You will notice the prolific growth surrounding this area. We have a tunicate, a number of rock oysters in this area, and bryozoans. There are also sponges, and barnacles, of course. It is clear that there is no zone of inhibition.

M&T is committed to performing all the required environmental studies with these chemicals on the ongoing EPA data reviews. It is only after thorough review of these data that M&T can make a responsible technical assessment as to the true effects of these chemicals in the environment.

Mr. Chairman, we urge you not to restrict the use of these chemicals while EPA is evaluating all these data. Thank you, and we welcome your questions.

Senator **Mitchell**. Thank you, Mr. Sheldon.

Dr. Huggett, welcome. We look forward to hearing from you. Just pull the microphone up close to you, Doctor, and speak right into it.

STATEMENT OF ROBERT J. HUGGETT, SCHOOL OF MARINE SCIENCE, COLLEGE OF WILLIAM & MARY

Dr. HUGGETT. Thank you. Mr. Chairman, members of the committee, my name is Robert Huggett. I am a professor of marine science, School of Marine Science, College of William and Mary. I have been involved in research on tributyltin for approximately four years.

Tributyltin is a toxic compound which is why it is used as a biocide in antifouling paints. It diffuses out of the paint, forming a layer around the hull of the ship at very high TBT concentrations. When the larvae of barnacles encounter this layer, they are either repelled or killed, as are other fouling organisms. It further diffuses into the adjacent waters where other plants and animals are exposed. It is this aspect of the issue that has caused concern in the scientific community of this country and other countries as well.

In the latter part of the 1970's, a significant decrease in the abundance of Pacific oysters, *Crassostrea gigas,* was noted in Arcachon Bay on the Atlantic coast of France. In addition, the occurrence of shell malformations, which had been rarely observed before, increased to affect eighty to a hundred percent of the animals. In 1980, TBT coming from recreational boats in the vicinity of the oyster beds was suspected to be the causative agent. In 1982, the French banned the application of antifouling paints containing TBT to hulls of boats under twenty-five meters, with hulls made of alloys being excepted. Since that period, the French have noted a significant decrease in the tin concentrations in the oysters, a significant increase in oyster production, and a dramatic decrease in the shell deformations.

The British have likewise observed similar effect on their oyster populations in areas of high boating activities. Their scientists drew similar conclusions to those derived in France. In January of last year, the British Government introduced regulations to prevent the sale of TBT paints containing 7.5 percent or more tin. They set a safe target water concentration of 20 nanograms per liter as a goal they would like to achieve.

On February 26 of this year, officials of their department of the environment issued a letter—and I have enclosed a copy in my testimony for your help—stating, and I quote,

> You will recall, the Minister for the Environment Mr. Waldegrave announced in July 1985 (copy enclosed for ease of reference) measures for dealing with the problems arising from the use of antifouling paints containing organotin compounds on small craft. It is now apparent that those measures have not brought the problem under control and that our water quality target set in 1985 is not strict enough to protect the most sensitive sectors of the marine environment.

They further state that they intend to reduce their target concentration to two nanograms per liter.

The biological effects induced by TBT on marine and estuarine organisms range from acute to chronic. At concentrations below 1,000 parts per trillion, some species are killed. For instance, the larvae of the Eastern oyster and the hard clam succumb to concentrations of about 1,000 parts trillion when exposed for 48 to 96 hours. Mortality of 50 percent of the larvae of mussels, *Mytilus edulis,* were observed to die when exposed to 100 parts per trillion for 15 days. There is some laboratory and field evidence that 50 parts per trillion or less causes the female dogwhelks, *Nucella lapillus*, to grow a penis, a phenomenon known as imposex. Under laboratory conditions, female European oysters, *Ostrea edulis*, show a propensity towards maleness—in other words, conversion of females to males—when exposed to several hundred parts per trillion.

Some of these species are native to the waters of our country. It is now important then to see what kind of levels we do have. Concentrations of 1,000 parts per trillion are common in some of our marina areas that have high boating activities and low flushing rates; in other words, low amounts of water coming in and out. In Virginia, the general trend in marina areas is for concentrations to be between 2 and 50 parts per trillion; there are some areas where concentrations are almost always over 100 parts per trillion. In shipyard areas that apply and remove TBT paint, concentrations are elevated relative to upstream and downstream.

Tributyltin does degrade, as you previously heard, but since elevated concentrations are found in waters which experience high boating activity, the degradation is not rapid enough to keep TBT below apparent toxic levels. We think that 70 percent of the TBT entering the Chesapeake Bay in Virginia comes from recreational vessels. Therefore, it is important to target this sector for control. That is why in Virginia we have banned the use and application of TBT on vessels under 25 meters in length.

Since other States have less shipping activities and the Navy is not as prominent in other States as it is in Virginia, the proportion or the percentage of TBT coming from the recreational sector will be larger in these other States. If anyone is allowed to use TBT, I believe it should be our United States Navy. Fleet readiness, fuel, and drydock savings are the reasons for my comment. I believe that we, at this time do not know the safe concentration of TBT in our waters. We do know it is extremely low. We do know that the use of TBT will likely increase in the future. We estimate that only 30 percent of the painted recreational boats in Virginia at this time use TBT. They will likely switch in the future.

I commend this committee for holding this hearing. I support proposed actions allowing only low-leaching paints and would further support a more stringent regulation banning the sale and use of TBT antifouling paints in the recreational sector, with aluminum vessels being excepted.

Thank you very much.

Senator MITCHELL. Thank you very much, Dr. Huggett.

Senator Mikulski, do you have questions of these witnesses?

Senator MIKULSKI. Yes, I do. The question that I have is directed at Dr. Huggett, but I would welcome comments by Mr. Sheldon. Could you tell me how long the TBT has been around and what was used to keep hulls clean before TBT?

Dr. HUGGETT. I believe that TBT was introduced in the early 1960's for the first time. That is my understanding. Thousands of years ago the Phoenicians used copper. We have used copper just about ever since. We have tried other things such as mercury and arsenic and DDT, but they didn't turn out to be very good either.

Senator MIKULSKI. In the testimony—and I am not a scientist—they refer to alternatives. They talk about the copper-based, then they talk about TBT, and then they talk about polymer-something-or-other. Are you familiar with this? Are they available in the marketplace? Would they be available to either commercial fishermen or recreation boaters?

Mr. HUGGETT. There certainly are copper-based paints available. There is one problem. That is that copper causes severe erosion when applied to aluminum boats, and that is why in Virginia we exempted aluminum vessels in our regulation. There are copper-based paints that are effective, and they are generating new formulations of paints which seem to be effective for longer periods of time. So there are indeed other alternatives.

Mr. SHELDON. Senator Mikulski, one of the problems is that copper-based paints are not effective in use by either commercial craft or the Navy because they will not last or meet the requirements by those two sectors. They have been used, however, as Dr. Huggett pointed out, for many years.

Senator MIKULSKI. Would, though, the alternatives described by Dr. Huggett be effective with recreational boats other than aluminum?

Mr. SHELDON. Oh, most certainly.

Senator MIKULSKI. So that there would be alternatives available to them. And when we talk about commercial vessels, I am not talking about container ships or Navy. We are not talking about oceangoing, we are talking about the lobster boats off the coast of Maine, the oyster and crab boats in the Chesapeake Bay. Would these alternatives be effective on those kinds of vessels?

Mr. SHELDON. I think you have to separate it out. We could categorize these materials in terms of use in four separate areas. We could talk about recreational use, which would be pleasure craft of a very small size. We could talk about the fishing fleet, which becomes a very important area because they also do go into the deep sea. Then you have, of course, what I consider commercial shipping. What I am referring to would be container ships, as you mentioned, oil tankers and other ships of that size. The Navy is the last category.

I think that copper for use on recreational craft would be very effective. It begins to lose its effectiveness as you consider the use by the fishing fleet. Their need is different because there is an economic factor that must be considered. They are quite stressed by the problems they have. Understand that when you take a large commercial ship and pull it into drydock, you are paying approximately $50,000 a day for drydocking costs alone.

Senator MIKULSKI. When you say a commercial ship pulled into drydock, what are you talking about? Are you talking about a lobster boat?

Mr. SHELDON. No, remember the category I am using is commercial licensed——

Senator MIKULSKI. That would be different than the fishing fleet?

Mr. SHELDON. Yes. It would be a large vessel.

Senator MIKULSKI. But in terms of the fishing fleet, which many of us are very interested in, and of course they are very stressed economically, would the alternatives all be effective for them?

Mr. SHELDON. I can't answer that. You know, one thing I should point out, Senator, we are the manufacturer of an active ingredient. We do not manufacture paints. I think you are going to have to direct some of your questions to others.

Senator MIKULSKI. Oh, I will. But you are kind of the source, if you will.

Mr. SHELDON. All right.

Senator MIKULSKI. Dr. Huggett?

Dr. HUGGETT. We believe, in Virginia, that copper offers a good alternative for the fishing fleet. That is why the Virginia regulations bans its use on anything under eighty-two feet in length, and most of our commercial fishing vessels, the crab boats, the clam boats and so forth, are all under eighty-two feet in length.

Senator MIKULSKI. Last question. In terms of the crab pots and lobster pots that the chairman mentioned, do you think the use of TBT on those offer any significant negative consequence?

Dr. HUGGETT. I think it certainly does add tributyltin to the environment.

Senator MIKULSKI. It tends to what?

Dr. HUGGETT. They do add. The dipping of nets and so forth and crab pots does add TBT to the environment. I feel—my guess is—that it is relatively small compared to the recreational fleet itself.

Senator MIKULSKI. Thank you.

Thank you, Mr. Chairman.

Senator MITCHELL. Thank you, Senator.

Senator Stafford?

Senator STAFFORD. Thank you, Mr. Chairman.

Dr. Huggett, as I understand it, you support the concept of no TBT in bottom paints on pleasure craft under 25 meters in length.

Dr. HUGGETT. That is correct, sir.

Senator STAFFORD. I also understand that it is considered that maybe only two parts per trillion of TBT in water is the point at which it becomes dangerous. Am I correct?

Dr. HUGGETT. That is what the British now believe, their Department of the Environment.

Senator STAFFORD. One of the witnesses who will follow later, I understand that the testimony will concern a number of points in the Chesapeake Bay. In particular, I notice that in Galesville, the Hartge boatyard, the parts per trillion run from 41 to 27 to 42, somewhere in the 20's and 40's, most of the year, but 186 parts in May, which I presume is the result of the spring fitting-out season. I would assume then that those levels are all too high in that area and that would be one reason for not using TBT in bottom paint on pleasure craft.

Dr. HUGGETT. That is my opinion, sir.

Senator STAFFORD. My recollection is that most of the commercial fishermen in the Chesapeake are wooden-hulled today—some may be fiberglass—and that they usually run around maybe 30 to 50 feet in length. You would exclude them from the ban on TBT's because of the commercial situation? Am I correct there?

Dr. HUGGETT. No, sir. In Virginia we did not, and I would not support that. I believe that the fishing fleet can use copper effectively.

Senator STAFFORD. All right. Thank you very much.

Thank you, Mr. Chairman.

Senator MITCHELL. Senator Stafford, thank you.

Senator Trible?

Senator TRIBLE. Mr. Chairman, I am having a little difficulty squaring the testimony of Mr. Sheldon and Dr. Huggett.

Mr. Sheldon, you say that this TBT business is safe. Dr. Huggett for 2 or 3 years has been telling me that it was time to take action, that TBT compounds posed a real hazard to our marine environment.

Dr. Huggett, I invite you to respond to Mr. Sheldon's rather cavalier statements that TBT compounds are safe.

Dr. HUGGETT. In discussing TBT research with scientists from England, Drs. Waldock and Thain, and Dr. Alzieu of France and discussing TBT research with scientists from the United States Navy, from Maryland and California, and my own research and the research of my colleagues at my institute, there is no doubt in my mind that there are concentrations in some of the marinas of our Nation which are harming marine and estuarine organisms.

Senator TRIBLE. Thank you, Dr. Huggett.

Mr. Sheldon, your company has two patents on TBT compounds; is that correct?

Mr. SHELDON. Yes, I think you are correct.

Senator TRIBLE. You are in the business of producing tributyltin, which in turn is used in paints?

Mr. SHELDON. Well, let me clarify something. There is no such thing as a chemical by the name of "tributyltin." Tributyltin is but one part of the name. There is another part or another moiety in the chemical that has to complete it, such as tributyltin oxide, tributyltin fluoride, tributyltin something else. Tributyltin is somewhat of an acronym that has been used repeatedly to describe these materials, however.

Senator TRIBLE. All right, sir. Well, this continues to be a learning process for me, and I thank you for that. Now let's respond to my question. What is it that your business does? Why is it that you are here today? I sense that you must have some economic interest at stake, and I would like to flesh that out for the record. What is it that your company does or makes or produces that makes this legislation of interest to you?

Mr. SHELDON. Well, organotins is a class of compounds of which tributyltins are but one.

Senator TRIBLE. Yes.

Mr. SHELDON. This matter is of great interest to M&T. There is no question, we have an economic interest in the material.

You made the statement earlier, Senator, and said that my remarks were somewhat cavalier. On the contrary, we are quite concerned about the effect of these materials in the environment. We have gone to the extent of acting and becoming part of the very figures that Dr. Moore referred to. We have cancelled some eighteen registrations of materials that fit into a category that we described as materials that just were releasing too much material to the environment. Our attitude is that it is unnecessary. We proceeded to cancel eighteen of those registrations.

Senator TRIBLE. Well, I don't want to get into a debate, and that was really not my purpose. I do, though, find it preposterous for you to suggest today that TBT paints are safe, in the view of the substantial scientific evidence that has come to all of our attention.

Research done in the United States and many other foreign countries, and the fact that today because of the dramatic increase in the use of these paints, the worldwide level is more than 35,000 tons annually. And it is increasing, it is not diminishing.

It seems to me that that should alarm all of us, and to suggest that the use of these paints is safe, is simply in error.

Let me ask my question one more time. What does M&T Chemicals do?

Mr. **SHELDON**. We are a manufacturer of chemicals that go into many different specialty markets.

Senator **TRIBLE**. All right, sir. And one of those chemicals is TBT?

Mr. **SHELDON**. One of them is, yes, that broad category of material.

Senator **TRIBLE**. And you then sell that compound to paint makers?

Mr. **SHELDON**. Exactly.

Senator **TRIBLE**. You are not in the paint-making business?

Mr. **SHELDON**. We are not.

Senator **TRIBLE**. What were your sales of TBT compounds last year?

Mr. **SHELDON**. I am afraid I don't have those numbers. We can get them and report them back to you later.

Senator **TRIBLE**. All right, sir.

If that would be an appropriate request, Mr. Chairman, I would ask that that be submitted for the record.

[The information requested follows:]

As requested, I herewith inform you that the 1986 domestic sales by M&T Chemicals Inc. of antifoulant TBT compounds was approximately 595 thousand pounds of technical material.

Our sales are to U.S. manufacturers of antifoulant paints who export some of their paints. We do not know what proportion of paints containing our TBT products are exported.

The majority of our product sales were of the tributyltin copolymers. The TBT copolymers allow the formulation of antifoulant paints which have a controlled and low release of TBT over time.

Senator **TRIBLE**. I thank Mr. Sheldon, and I thank Dr. Huggett not only for his testimony but for his leadership over many years in pointing out the potential hazard of TBT compounds.

Senator **MITCHELL**. Thank you, Senator Trible.

Thank you, gentlemen, for your testimony here today.

The next panel will include Admiral M.V. Ricketts, Department of the Navy, Naval Sea Systems Command; and Mr. John W. Ludgate, Jr., marketing manager, International Paint Company.

STATEMENT OF ADM. M.V. RICKETTS, NAVAL SEA SYSTEMS COMMAND, DEPARTMENT OF THE NAVY

Admiral **RICKETTS**. Good morning, Mr. Chairman, Senator Trible. I appreciate the opportunity to present my views on tributyltin paints as used by the Navy and their effects on the marine environment. Because I am limited to five minutes, I have provided written responses, and I will use my five minutes just to set the stage.

The Navy and the United States has been engaged in the formulation of research on antifouling paints, including organotin paints, since 1970, and we have been conducting research on the effect of these tributyltin paints since 1976. It is only more recently that the other organizations have joined this effort. From the very beginning, the Navy has been concerned with the effect on the environment and the safety of the utilization. We have taken reasonable steps to minimize the effects which could occur to the environment. Our safety procedures are now standardized.

We have concluded that the tributyltin paint formulations specified by the Navy constitute a minimal hazard to the environment, and we have reached this conclusion after over ten years of R&D. If all the ships in the Navy were painted with the Navy-specified paints, our contribution would be less than two percent of the tributyltin leached into the coastal waters today.

I want further to set the stage by discussing the differences in the requirements for tributyltin paints between steel-hulled and aluminum-hulled ships, and also measurement techniques. In our paint formulation for steel-hulled ships, we use a combination of tributyltin and copper. Copper is added simply to reduce the amount of tributyltin necessary for effective antifouling. These paints are totally satisfactory for use on steel-hulled ships. In the case of aluminum ships, copper has the potential to attack the hulls by galvanic corrosive action. Therefore, antifouling paints for aluminum-hulled ships are restricted to tributyltin variety and we have no identified alternative.

There have been articles on so-called teflon paints, which are advertised to have very slick surfaces such that sea growth cannot attach themselves to the hull. We tried those paints. They didn't work. I personally jumped into the water with a snorkle. I examined a hull with this paint, and I have got scratches on my body to attest that there were barnacles on that hull. They were rapidly formed, and they were persistent.

With respect to the measuring techniques, the EPA, the Navy, and others obtained similar results for oganotins in the water. That is, we all get the same answer when we measure the same water. However, when we discuss leach rates, which is the rate at which organotin leaves the painted hull, the Navy method and the EPA method differ, and for good reason. The Navy chooses to measure the leach rate from flat plates sitting in still water because this closely represents what will actually be leached in the water by Navy ships. This is a slow and relatively expensive process. The EPA paints a cylinder which is then rotated at 60 r.p.m. The results are repeatable, and they are quickly obtained. However, they do not represent actual leach rates from ships into water. The scrubbing action of the water as it rapidly passes over the painted rotating cylinder is the reason that the EPA leach rates are higher. For example, a relatively soft paint will have a leach rate significantly higher on a rotating cylinder, whereas a hard paint will only raise the leach rate slightly because the scrubbing action affects soft paint more.

The Navy has no problem with the EPA measurement technique as long as the difference is understood and the values used permit the Navy to continue utilization of the low-leach-rate paints which we advocate.

Finally, with respect to the pending legislation, I note that the Virginia and Maryland legislatures have both passed bills permitting five micrograms TBT centimeters per day for the paints to be used for steel hulls above 25 meters in length. These same bills exempt aluminum hulls from the regulations. The U.S. Navy finds these State bills acceptable and in agreement with our recommendations to you today.

Specifically, we request that S. 428 have the following additional provisions: first, that the maximum acceptable release rate for steel hulls should be five micrograms of TBT per square centimeter per day instead of .5 by the EPA method; two, the aluminum-hulled craft must use TBT antifouling paints and therefore should be allowed to use them without restriction; and finally, we request the language relieve the Navy of the current ban on its TBT paints.

Thank you, sir.

Senator MITCHELL. Thank you very much, Admiral.

Mr. Ludgate, welcome, and we look forward to hearing from you.

STATEMENT OF JOHN W. LUDGATE, JR., MARKETING MANAGER, INTERNATIONAL PAINT CO.

Mr. LUDGATE. Thank you, Mr. Chairman. My name is John Ludgate, and I work for International Paint Company, which is the world's largest manufacturer of marine paint coatings. As we heard this morning, this is a very complex issue, debating the use of TBT and marine paints and the environment. It is for this reason that International Paint and other paint manufacturers fully support the EPA and their data call-in and recommend that any legislation be postponed until the EPA has an opportunity to rule on either interim or final regulations.

I was asked by the chairman to address the technological aspects of antifouling paints as well as the economic impacts which would be felt in the industry if this or other legislation was passed.

In my prepared testimony I covered five areas: why we use antifouling paints; the different technology available and how tin is used with these products; the impact of this bill and also the impact of a total tin ban on the marine industry; what alternatives are available to us now and in the future; and what the recommendations are from industry.

Due to the shortness of time, I just want to hit on a few points. Basically, there are two ways in which we incorporate tin into different types of paint. Mr. Moore touched on it earlier this morning. There are free-associated paints, where the tin is just physically added to the paint and mixed in. It is much harder to control how much tin is released from this kind of paint because it is just randomly dispersed throughout the paint film. It's not connected to anything.

The other type of product, which is a newer technology, is called the TBT copolymer paint. Here the tin is actually chemically reacted to the end of a copolymer which is water-soluble. It is the first time where we can control how much tin is going to come off of the paint film due to the solubility of that copolymer.

This represented a breakthrough for industry and the shipping industry, because for the first time we could predict with certain accuracy how long a ship would stay clean depending upon the thickness of paint which was applied.

Another concern is that of blasting the material. After a ship uses any kind of paint, after a three- or five-year period, it will come out of the water—I am speaking now of commercial vessels—it will come out of the water and new paint will need to be applied. With the copolymer paint, you simply high-pressure water wash the surface and apply a new layer of paint. With conventionals and sometimes free-associated paints, you have to blast off the old paint which causes a disposal problem because you still have biocide in the spent paint film.

An important aspect which must be represented is the performance factor. With a TBT copolymer paint, 99 percent of the vessels after a 24-month period will have a totally clean hull. This is only 65 percent with the free-associated paint and 45 percent using a conventional copper-only paint.

International Paint has been keeping track of these figures for over 10 years, and we have 16,000 vessels which we have been tracking. So this is very competent, statistically correct data.

When discussing the release rates, there is much discussion between the two different methods and what the number actually means. I am glad to hear that Senator Trible had put forth the change of the release rate to 5.0, not so much that it represents an increase, but this is strictly an adjustment of the maximum release rates for the tests now being employed by the EPA.

On a short-term basis, there are no alternatives to the TBT products. We have heard some mentioned that why don't we just use copper paint. Before the addition of tin to copper paints, mercury, DDT, and some arsenic compounds were used. Unfortunately, there are certain strands of seaweed which are not affected by copper, and therefore there was always a booster needed to be put into the copper paints. On a long-term basis, we are looking for alternatives. Ideally a nontoxic biocide is our end goal. However, this is five to ten years away.

What would be the impact if tin was banned completely? We estimate that for a large marine ship operating costs will increase 25 percent if it had to go back to conventional copper-only paint. This represents $200,000 to $400,000 per year per vessel. The shipping industry is on very tough times these days, and to add uncompetitive pressures to the U.S. merchant fleet would put us in even a worse position.

Basically, this is going to affect shipyards in the United States because there is so much money involved here, that it is worth it to the shipowner to take his ship to another country to get these kinds of paints applied. This already happens often because of labor rates in the Far East as opposed to the United States.

In the recreation sector there has been previous mention that aluminum hulls cannot use copper only paint. Also, outdrives and outboard motors as well as underwater metals which are used on recreational vehicles are also made of aluminum and soft alloys, and there is the same problem of galvanic corrosion if copper paint is used.

The impact of this bill would move the industry away from high-release paints by setting this release level. These levels would still allow the merchant marine to operate effectively and would still be an alternative for the recreational sector.

However, as I said from the onset, this is a complex issue, and our position is that we recommend that any legislation be postponed until the EPA has an opportunity to completely review the facts here and make interim or final regulations.

Thank you, Mr. Chairman.

Senator MITCHELL. Thank you. Mr. Ludgate, we have received written testimony from several groups and individuals. One of them was the Environmental Defense Fund. You, in your testimony, cited a number of advantages of TBT copolymer paints. You referred to three types of paints in your statement: copper, TBT free association, and TBT copolymer.

In their testimony the Environmental Defense Fund indicated that we should also consider another type of paint, copper copolymer. Are copper copolymer paints available, and is it fair to compare TBT copolymer paints with copper conventional paints for cost purposes? If there are copper copolymer paints are available, wouldn't that be the proper comparison? Are they in fact available, do you know?

Mr. LUDGATE. Mr. Chairman, I am not aware of any copper copolymer paints available. Unfortunately, when we describe paints, whether we use copolymers or ablative or eroders, these are general terms, and sometimes products try to be lumped into a generic category, "copolymers," when in fact the mechanism that we are referring to, they are not. And I am not aware of a copper copolymer per se.

Senator MITCHELL. Would you, to help the committee resolve this matter, review the statement of the Environmental Defense Fund and provide us with a written critique or response to it, as to any of the points raised in it?

Mr. LUDGATE. I certainly will.

Senator MITCHELL. We have obviously got two points of view expressed here, and I would like it if you could do so, review it and give us a written submission.

Mr. LUDGATE. Yes, I will do that, Chairman.

Senator MITCHELL. Thank you very much.

Admiral RICKETTS. May I address that, sir?

Senator MITCHELL. Yes. Surely.

Admiral RICKETTS. The Navy is dealing with a copper ablative paint, which I think is probably the same thing that the Fund is talking about.

Senator MITCHELL. I see.

Admiral RICKETTS. And we have those in our R&D development program. We have them on some numbers of ships today. We are far from reaching a conclusion on these paints, but we are working on them as an alternative to tributyltin. If they prove successful, we would use them.

The indications are that they are effective, but probably not to the length of time, but we don't know that yet.

Senator MITCHELL. Perhaps I might ask you, Admiral, to give us a written statement on that as well after you review the Environmental Defense Fund's statement.

Admiral RICKETTS. Yes. I think that is included in my statement, a brief description of that already, in the written portion of the statement.

Senator MITCHELL. Fine. Thank you.

Senator Mikulski, do you have any questions of these witnesses?

Senator MIKULSKI. Yes, I do have a question in terms of the boats and International Paint, Mr. Ludgate. Mr. Ludgate, you heard Dr. Huggett's testimony on essentially pointing out who he thought could use TBT's and others who don't. Then we talked about the use of alternatives by fishing fleets and recreational boaters as compared to the Navy or large oceangoing commercial vessels who tend to dock only in a temporary way.

As you know, recreational boaters tend to use the marina, and they are going to be in the harbor a long time. My question to you is what is your comment to the Huggett testimony? Second, could you give me a price range as to what these alternatives are?

Mr. LUDGATE. First of all, in regard to the fishing industry, whenever a vessel is used in any commercial aspect, where you are using the vessel to either make a living or as part of a business, then the impact of antifouling paints become much more important because typically, if the bottom of a ship regardless of its length is fouled, 33 percent of the ship is fouled, that adds 50 percent increase to the fuel costs. Now, whether it's a small fisherman who is fishing in the Chesapeake or off the coast of Maine, I doubt that he will be able to absorb a 50 percent increase in fuel costs that easily. This also applies to large ships as well as the Navy ships, as they indicated, with the amount of dollars here. Obviously, for a small vessel it's a small aggregate, but for that fisherman I am sure it's just as important.

In the recreational sector there are no clear-cut economic benefits that way because the vessels are not used in that same type way. They are strictly for recreation or pleasure craft, and the argument isn't as clear-cut and the copper alternatives are available.

Senator MIKULSKI. This is my time. Could you come back to my question in terms of the cost? If a waterman or a lobster fisherman wanted to go buy the alternative paints to use on his fishing fleets, what would be the cost to him? My watermen have indicated that as supportive as they are of cleaning up the bay, that these could cost as much as $100 per gallon. Is that true?

Mr. LUDGATE. I am sorry, Senator, are the fishermen indicating that to go from a copper paint to a TBT paint?

Senator MIKULSKI. No. To go from TBT paints to the alternatives, they indicate their concern that either scarcity, variety of alternatives available, that these alternatives are very costly. My question to you, since you are in the paint business is what is it? Is this so, and what is the cost of, say, a gallon of copper-based, but not copper paint?

Mr. LUDGATE. Right.

Senator MIKULSKI. The combination alternative.

Mr. LUDGATE. Yes. The actual cost of the gallon of paint is cheaper for a copper-only product because there is only copper in there as opposed to having copper as well as tin. So, on a price-per-gallon, it's cheaper. I think they may be alluding to the fact that it is costly because they have may have to expend more fuel because they are not as effective.

Senator **Mikulski**. Well, the norm then is the sleeker the hull the more efficient the engine? Isn't that it?

Mr. **Ludgate**. Well, the less fuel you will use, yes, Senator.

Senator **Mikulski**. So the copper only is not as expensive as a copper-combination?

Mr. **Ludgate**. That's correct. But it's predictable performance is substantially less than that combination, as we call it.

Senator **Mikulski**. Well, what is the cost of a copper combination paint per gallon?

Mr. **Ludgate**. Well, it depends upon whether it's a commercial or a recreational sector. In a commercial sector you're typically talking about $40 to $45 a gallon and a copper-only paint could cost $30 to $35. These are very general numbers because there are all different concentrations.

Senator **Mikulski**. No. I understand. I understand that. Then a gallon of paint covers what length of surface?

Mr. **Ludgate**. Well, typically, if you had a 100-foot fishing boat, I am just guessing now, but I would say you probably could use ten or fifteen gallons for that. A fishing vessel, we're not talking about a large volume of paint. But the cost there is in the fuel. It's hard for me to give you accurate numbers. I can give you ballpark estimates in a written reply to that.

Senator **Mikulski**. No, I am interested in ballpark numbers.

Mr. **Ludgate**. OK.

Senator **Mikulski**. I am interested in ballpark figures. We just want to make sure we don't hit any foul balls on the committee, that's the only thing.

Thank you, Mr. Chairman.

Senator **Mitchell**. Thank you, Senator Mikulski.

We are pleased that Senator Lautenberg has been able to join us. He has been chairing another hearing this morning.

Senator, welcome.

Senator **Lautenberg**. Thank you very much, Mr. Chairman. As you would guess, coming from the State of New Jersey, with its extensive coastline, very significant presence in commercial fishing, recreational fishing, and just the general marine industry, and also being a boater, a sailor, and knowing how advantageous some of these paint substances are in terms of keeping the hull clean, reducing the barnacles, reducing the labor, nevertheless there is a major environmental concern here. Since this committee is the Environment Committee and has the responsibility for trying to keep our country as clear of pollution as we can, that of course includes the waterways and the seas.

I am very interested, Mr. Chairman, and I compliment you and our colleagues from Virginia and Maryland for their interest in this subject. All of the States represented here are States with very significant coastlines and very significant boating industries. So we are interested in the subject. Our interest is in protecting the environment. That is our responsibility.

Senator **Mitchell**. Thank you very much, Senator Lautenberg.

Senator Trible?

Senator TRIBLE. Thank you, Mr. Chairman.

Very briefly let me just mention a couple of points in response to points made by Mr. Ludgate and say a word to the Navy, and then I guess it's time for us to leave.

But, Mr. Ludgate, in response to your testimony that there are no satisfactory alternative biocides to the use of TBT, let me say that according to one of your major competitors, Devoe Marine Coatings Company, a major manufacturer of antifouling paints, they say that technology does exist to maintain all of the benefits previously associated with TBT antifouling without using TBT.

Mr. Chairman, I would like to submit a statement from Devoe just so we will have a more complete record.

Senator MITCHELL. That will be included in the record. (See p. 130.)

Senator TRIBLE. Also, you mentioned the adverse impact on shipyards if TBT paints were no longer available. Let me say that the largest shipyard in America, Newport News Shipbuilding, does not use TBT paints because they believe that it poses a risk, and not just to the marine environment but to their workers. I commend Newport News Shipbuilding for that wise decision and the leadership that they have shown by obviously turning away potential business because there are substantial risks associated with the use of these paints. I wish that attitude would be more pervasive in the business community.

Let me say to Admiral Ricketts that I commend the Navy for its good faith. The Navy has always sought to go the extra mile in meeting current standards on how TBT paints could be used safely. However, when Secretary Lehman told me that he was going to paint the entire fleet, I said, "No."

When he persisted, I went to the floor, and my colleagues agreed that we should stop that fleetwide painting exercise until all the evidence was in.

We have, however, attempted to meet some of the needs of the Navy by permitting the painting of aluminum vessels, and the Navy is now undertaking studies that will shed more evidence on the use of TBT paints, and I am pleased the Navy is doing that and would hope that you would keep us abreast of those tests. I think the test in Pearl Harbor is just what, a month old at this point?

Admiral RICKETTS. It is. The results are exactly as predicted. We can't even measure the impact.

Senator TRIBLE. I understand.

With that then, Mr. Chairman, I would ask permission to submit some questions for the record, possibly to these witnesses and to the witnesses that follow.

Senator MITCHELL. Fine.

There will be questions, written questions, permitted by any Senator of any witness, and we ask that the witnesses cooperate and provide the responses as quickly as possible.

Senator MITCHELL. Gentlemen, thank you very much for your testimony. It has been helpful, and we look forward to working with you on this.

Mr. LUDGATE. Thank you, Senator.

Admiral RICKETTS. Thank you, sir.

Senator **Mitchell**. The final panel of witnesses includes Mr James Seif, Regional Administrator, Region III of the Environmental Protection Agency; the Honorable Torrey Brown, secretary of natural resources of the State of Maryland.

A scheduled witness was Mr. Richard Burton, executive director of the Virginia Water Pollution Control Board, who is represented by Ms. Smith.

Welcome, Ms. Smith, and gentlemen.

Senator Trible and I are members of the select committee investigating the Iran/contra matter. That committee has a meeting scheduled at noon in the Capitol. So we must leave to go to that meeting. Senator Mikulski will chair the hearing for this final panel. We apologize to you for our required departure. We assure you that we will review your testimony as we consider action on this in the future. We thank you very much for coming.

Senator Mikulski, we are grateful to you for concluding the final panel on the hearing. Thank you.

Senator **Mikulski** [presiding]. On behalf of the subcommittee we would like to welcome all of those who are here. A particular welcome to Dr. Brown of the State of Maryland, who I know chaired the Maryland Chesapeake Bay initiative program. Having said hello, we would like to proceed with the testimony from Mr. Seif, regional administrator of EPA, then to Dr. Brown, and then to Ms. Smith, who I understand is substituting for Mr. Burton. Is that correct?

Ms. **Smith**. Yes.

Senator **Mikulski**. Mr. Seif, would you proceed?

STATEMENT OF JAMES M. SEIF, REGIONAL ADMINISTRATOR, REGION III, ENVIRONMENTAL PROTECTION AGENCY

Mr. **Seif**. Thank you, Senator Mikulski. Region III is very proud of its role in the Chesapeake Bay. We hope we can be helpful to the committee this morning. We also appreciate the long-term interest and leadership that you have shown, along with Senator Trible and many others in fighting the good fight concerning the bay.

My testimony can be summarized in one minute. In 1986, during that boating season, our Chesapeake Bay Liaison Office in Region III went looking for TBT in bay waters. We found it. We found it in a pattern chronologically and geographically that connects TBT presence in bay waters to TBT use on boat hulls. It's that simple. The specifics are outlined not in my testimony but in the study which is appended thereto, which describes the sampling methods, the survey design, and at pages 4, 5, and 6 of the testimony, the results.

The spike in May is similar in all four harbors that we looked at, and the constant presence of TBT thereafter during the boating season was also apparent. The numbers are before you. The fact is that the numbers, even as they levelled off, are higher than proposed water quality standards, and I think that is some cause for concern.

I do believe, however, as Dr. Moore testified, that the appropriate tool for use here, even with its imperfections, is the pesticide law. The agency's efforts under that law are well underway, as Dr.

Moore described, and it may be the most prudent thing to do. With all deliberate speed let that process run its course.

In any case, I am happy to be here this morning and will be happy to answer questions at the appropriate time.

Senator Mikulski. Thank you, Mr. Seif. Your testimony will be entered in the record.

Mr. Seif. Thank you.

Senator Mikulski. Now, Dr. Brown?

STATEMENT OF TORREY C. BROWN, M.D., SECRETARY OF NATURAL RESOURCES, STATE OF MARYLAND, ACCOMPANIED BY MARK BUNDY, DIRECTOR OF SPECIAL PROJECTS, DEPARTMENT OF NATURAL RESOURCES, STATE OF MARYLAND

Dr. Brown. Thank you, Madam Chairman. My name is Dr. Brown, from Maryland, the secretary of the Department of Natural Resources. Maryland has taken action as far as TBT is concerned. The Governor has written our congressional delegation, you have that letter, and we will submit that for the record. Recognizing that you don't need to have anything repeated, I would just like to be very brief. Maryland and Virginia thought there might be a problem, went out to study as to whether or not there was TBT in the water, found that there was, and then passed legislation to control TBT's use in Maryland.

I have got three, I guess, comments that might be helpful. First, in Maryland, absolutely no one objected to what we did. There was not an opponent at any of the hearings that were held on this topic. Specifically, the legislation was supported by the marine trades industry and the recreational boating groups of all types.

So no one opposed what we did to control TBT in Maryland.

Second, and I guess it is semiphilosophical, but if someone told you that they had a compound available that if you added a drop of it to 100,000 tankcars of water, it would kill living things, the first thing you would say in response is, "My Lord, don't let that get in the water." That, in essence, is the kind of things we're talking about now. We don't have all the answers, but we know that we need to do something significant.

Last, the kind of issue that we are talking about here today is exactly the kind of issue and specific topic that we are always looking for as far as the bay is concerned. We know there are a lot of things wrong with the bay and a lot of things need to be fixed. But one thing we would like to do is find specific, individual items that we can attack and solve, and that is what this is.

So we would like to be helpful in the furtherance of this legislation and perhaps in the drafting of it. And we support it.

Senator Mikulski. Thank you, Dr. Brown.

Would you introduce the gentleman at your left?

Dr. Brown. Yes. Mark Bundy is the director of special projects for the Department of Natural Resources, and for Maryland has been responsible for all of the follow-up and follow-through on this topic in Maryland. So he is very knowledgeable.

Senator Mikulski. Thank you.

Mr. Bundy, we wanted to be certain to acknowledge your presence.

Ms. Smith?

STATEMENT OF VELMA SMITH, MEMBER, VIRGINIA WATER CONTROL BOARD, STATE OF VIRGINIA, ACCOMPANIED BY RICHARD AYERS, AQUATIC ECOLOGIST

Ms. SMITH. Thank you, Madam Chair. I am Velma Smith, a member of the Virginia State Water Control Board, and I am standing in today for John Daniel, Virginia's Secretary of Natural Resources, who could not be here this morning. Also, business in the Tidewater area kept Richard Burton, the Executive Director of the State Water Control Board away this morning, and both Mr. Burton and Secretary Daniel has asked me to convey their appreciation for this opportunity to state Virginia's strong support for controlling TBT antifouling paints.

Virginia has already taken a number of important actions with respect to TBT and has worked cooperatively with EPA and the State of Maryland in particular in light of our concerns with the Chesapeake Bay. We are pleased to see congressional interest in TBT, and we are delighted to hear this morning your appreciation for the need for expeditious national action.

You have heard this morning also from scientific experts, and I won't attempt to comment on the specifics of the research findings which Virginia reviewed in development of its TBT policy. Rather, I comment from the perspective of a State official with responsibility for the overall health of water resources.

Given this responsibility and given the information collected on TBT, the Virginia State Water Control Board has determined that it is unwise to continue to stress our sensitive and valuable marine ecosystems with increasing levels of TBT. We also believe it is unnecessary to do so. As you have already heard, the use of TBT is growing, and left to itself, we believe the problem would get worse.

However, TBT has a comparatively short halflife. Thankfully, this means that reducing the amount of TBT entering the waterways by a sufficient amount will eventually eliminate the threat.

The important questions that you have focused on this morning and that we face in Virginia are: what is a sufficient reduction to accomplish the task of water resource protection; and two, how do we reduce the amount of TBT entering our waterways?

In looking at those questions and the other related questions regarding who is in a position to act, we conclude that the Federal Government regulation of TBT is required. The problem of TBT control is a national problem. The waterways at risk deserve the protection that only the national Government can provide. Meanwhile, however, State actions are very much in order, and Virginia has made a beginning which is just part of the job of controlling TBT.

In 1985, when we first learned of the Navy's proposal to paint its fleet with TBT, Virginia was active in pointing out unresolved questions in the Navy's environmental assessment. We learned quickly that TBT was a popular ingredient in boat paint, with an apparently high level of toxicity. We lost little time in joining forces with EPA and with your own State of Maryland to ascertain what might be done. In early 1986 we began sharing information on a regular basis concerning the extent of TBT in waters where our interests coincide.

Research of the Virginia Institute of Marine Science, supported with funding, in part, from the State Water Control Board, indicates that although we have not at this time documented an impact on marine life in the Chesapeake Bay from TBT, potentially harmful levels of TBT do occur in waters adjacent to our marinas and shipyards. The Water Control Board is concerned about that data, and we have already announced our intention to establish a water quality standard for TBT. Selecting an appropriate umber of this standard is not, as you understand, an easy task, and it is made more difficult by the absence of Federal water quality criteria for TBT.

We are, or perhaps I should say were until this morning, anxiously awaiting announcement of criteria from EPA.

In addition, our State Government has made a systematic investigation of its own TBT use, and as a result of that investigation we have determined that the limited number of uses to which TBT had been put would be discontinued. Also, late last year the Virginia Department of Agriculture and Consumer Services held a hearing to give its Board a basis for reconsidering the State-level registration of TBT.

As a result of data obtained through that review and elsewhere, Virginia has imposed significant restrictions on the use of TBT paints.

The following requirements have been imposed: Effective March 31, 1987, the use of TBT antifouling paint on boats shorter than 25 meters was prohibited unless the boat has an aluminum hull. Also effective on March 31, the use or sale of TBT in concentrated form as a paint additive was prohibited. Effective on July 1, 1987, TBT paint with an acceptable release rate may only be distributed, sold, or offered for sale or applied or possessed by commercial boatyards. TBT paint with an acceptable release rate may be used only on boats over 25 meters or boats with aluminum hull and may be applied only within a commercial boatyard. TBT paint with an acceptable release rate may be sold in spray cans of 16 ounces or less for aluminum fittings, outboard motors, and the like.

Based on information available regarding test methods, Virginia has defined acceptable release rate as a measured rate of release not to exceed five micrograms per square centimeter per day, as determined in accord with the EPA test method.

While State restrictions such as Virginia's can be very effective, State restrictions alone cannot do the job. We believe that the interstate and international nature of commercial boat traffic demands that the Federal Government play a significant role in controlling TBT.

In our view, Federal legislation should impose restrictions akin to those in Virginia's legislation and should set appropriate penalties for violations. It is important that Federal legislation include release rate restrictions as well as a ban on the use of all TBT-based antifoulants on recreational vessels. As you heard this morning, it appears that 70 percent of the TBT residues are due to those recreational vessels.

Finally, some attention to the international trade aspects of the problem must be reflected in Federal action. We believe it would be fully appropriate for the United States to seek commitments from other nations to limit or ban TBT paint. At the State level we cannot address such matters.

I hope this brief background on the measures which Virginia has taken will be helpful in your efforts to develop an appropriate Federal response.

Thank you again for the opportunity to testify, and we would be happy to try to answer any of your questions.

Senator MIKULSKI. Thank you very much, Ms. Smith.

Before I go into questions on behalf of myself and the committee, I would like to make a comment. I would like to congratulate the two States, their Governors and their respective legislative bodies for enacting legislation and not just deferring to the Federal Government.

What also is encouraging to those of us in the Federal Government is that something I will call the "vague process" is actually working. As you know, after a significant amount of money was spent doing studies of the bay and then the gubernatorial efforts, the multi-State efforts, and that of Mr. Ruckleshaus and being implemented by Mr. Thomas, we essentially came up with something called the "law of the bay," for want of a better word, and established certain organizational structures like the Bay Commission, like the Bay Regional Task Force. Obviously, it worked. Now what has happened in many ways is that State initiatives of the affected parties is now becoming a model and a stimulus for what we want to do nationally.

So it is a source of a great deal of pleasure, if you will, to see that an idea is now being implemented and in a way that does not disadvantage any one State over another. So we are delighted.

Mr. Seif, let me go to some questions. But I saw you nodding your head on my comments on the bay process. Did you?

Mr. SEIF. Yes, ma'am.

Senator MIKULSKI. Because we spent a bundle here on the bay and will continue to do so.

Mr. SEIF. I might say that it is very well to champion the process that has developed here because it really has borne fruit. Indeed in this very area of TBT, it was the Chesapeake Executive Council, which I chaired at the time, which passed a resolution concerning TBT and notified the Department of Defense and EPA. I wore a different hat under that circumstance by notifying my own Agency about TBT.

I would like to think that that helped to get the ball rolling in the individual States. The recent passing of the chairmanship from the Federal Government to one of the States, namely Virginia, demonstrates a maturation of the process, a building of trust, and an increased sophistication about how we are all in this together. It really bodes well not only for this issue but so many others connected to the bay.

Senator MIKULSKI. Well, I agree. I would like to go on, though, to some of your specific work on the TBT issue. I was interested to hear your testimony that the numbers in your test may be underestimated by as much as 50 percent. Is it safe to conclude that the numbers you reported are generally low by a substantial amount, and do you expect to improve your lab test to get a more accurate estimate?

Mr. **Seif**. Yes, Senator. Our indications are that transportation under refrigeration conditions to the lab and lab techniques themselves may understate the findings. When the quality assurance process is fully complete, we would like to report to you, if time permits in your legislative process, any different findings we may have.

Senator **Mikulski**. Is it your view that the water quality numbers to be established by EPA should reflect a larger-than-usual margin of safety, given the underestimation of TBT levels and the possible inaccuracies or understatements in the tests?

Mr. **Seif**. Rather than building in specific larger margins for specific chemicals because of lab techniques, I think we should attack the problem of lab techniques first, and that is what we are doing. Let's get the right numbers and not fuzzy ones. If the numbers have to remain fuzzy, then as an advocate for the environment in general and the bay in particular, I would have to answer yes to that.

Senator **Mikulski**. In talking with fishermen, they tell me that EPA had told them that TBT was safe. Would you comment on that, that this is a certified okay product to use?

Mr. **Seif**. No fisherman has asked me that question, and I am glad they didn't, because I am certainly not the expert. I don't know whether the question was asked is it safe for me as a fisherman to use it?

Senator **Mikulski**. Well, they didn't comment that it was safe to drink, but they did imply that it was safe, that EPA had okayed its use in fleet fishing activities.

Mr. **Seif**. I think, far from okaying its use, our special review raises the very question about whether the use is okay. And we are taking a look at that in the fashion that Jack Moore described.

Senator **Mikulski**. Dr. Brown, did you want to elaborate on that?

Dr. **Brown**. It is an acceptable product as far as pesticides is concerned. So in that sense that it was at one time sanctioned for use——

Mr. **Seif**. If someone asked if it was legal, yes.

Dr. **Brown** [continuing]. It is a legal product for use as a pesticide under regulations published by EPA, and it has to be taken out of use as a pesticide via the process that you heard described earlier.

Senator **Mikulski**. Mr. Seif, will your findings of very high levels of TBT in the bay help speed forward the EPA effort to address the problem under the pesticide law?

Mr. **Seif**. Yes. And that was one of the purposes that Dr. Moore had in working with us to design that summer's worth of testing.

Senator **Mikulski**. Thank you. Now, questions really for both Ms. Smith and Dr. Brown. You have both dealt with this issue in your States and with groups affected by the restrictions. And please feel free to comment, Mr. Bundy.

Did you develop educational programs before implementing the regulations? And could you describe your efforts and the general public reaction to this?

Dr. **Brown**. I think it probably wouldn't be fair to say before, but coincident with the entire process that led up to legislation, we did develop educational programs. In fact, the law which we helped write instructs us to continue to do that. I guess witness that the educational program worked was that the marine trades association, the marina operators and the recreational boating groups, because of the education, supported the legislation. We will be continuing to talk to boat owners via their license application, to all the marine trade groups as we have been, and tell them why this is necessary and to continue to educate them.

Senator **Mikulski**. Mr. Bundy, did you want to elaborate on that, or Ms. Smith?

Ms. **Smith**. Senator, if I could, I think that our answer would be similar, in that we did not have an education program prior to legislative and regulatory action, but we are working on education.

If I can introduce Richard Ayers, of the State Water Control Board, who might want to comment on our educational effort.

Senator **Mikulski**. Certainly. Mr. Ayers, would you want to pull up your chair a little bit closer?

Mr. **Ayers**. The law passed by the Virginia General Assembly does require an educational program to be a cooperative effort between the Agriculture Department, the Water Control Board, and a couple of other State agencies. There is an education program associated with the prohibitions in the law.

Senator **Mikulski**. And as both States went about their work, what was the general public reaction to the loss of TBT paints among recreational and commercial users? Mr. Ayers? Mr. Ayers, or Ms. Smith, when you were doing this, what was their reaction?

Mr. **Ayers**. The hearing that was held by the Agriculture Department on the registration of TBT as an antifouling paint, I guess, indicated the position that people would take. The shipping industry, I think, was represented by people who have been here today, and you have heard what their positions are. They are generally not in favor of a complete ban but, in general, are in favor of a review of the registration. The environmental groups in Virginia were more in favor of an overall ban or elimination of the use of TBT because of its environmental problems.

Senator **Mikulski**. What was the reaction of recreational users, recreational boaters?

Mr. **Ayers**. As far as I know, recreational boaters have not made their views public, at least at the forums that I have been at.

Senator **Mikulski**. Ms. Smith?

Ms. **Smith**. The only thing I might add is—and this just came across my desk the other day—but I have noticed that the National Wildlife Federation has a pamphlet, an educational pamphlet, I think, that is geared primarily toward the recreational owners, trying to educate them on this matter and let them know about the problems with TBT boat paint.

Senator **Mikulski**. Dr. Brown?

Dr. **Brown**. Our recreational boaters were openly supportive, came to the hearings and testified in support of it. They said that they are interested in seeing the bay cleaned up and if this would help, they would be supportive. The real difference between what they used to use, copper-based paint—and they will have to go back to—and TBT is that you need to do it more frequently, paint the bottom of the boat more frequently. But the paint costs remarkably less than TBT. So it is a trade-off in a way.

Senator MIKULSKI. What was the reaction of the watermen?

Dr. BROWN. The watermen were also supportive, and they recognize that they will have to paint their boats more frequently, but they say they are not harming the resource, that they are there to harvest.

Senator MIKULSKI. So the watermen supported the Maryland bill?

Dr. BROWN. Yes, ma'am.

Senator MIKULSKI. Does the Maryland bill also include things like crab pots or is it strictly limited to vessels?

Dr. BROWN. No, it is strictly limited to vessels because it attacks or it controls paint that is applied to vessels. We know that crab pots and nets have some TBT treatment. But so far we think that it is not remarkable as a contributor.

Now, what we also will do is to continue to monitor. If this action we have taken does not decrease the level of TBT in the water, then we will add other prohibitions in the future.

Senator MIKULSKI. In your testimony, both Ms. Smith and Dr. Brown, we heard about the question of the bioavailability of TBT to aquatic organisms. In other words, there is some question whether TBT released to water is bound up in sediments and therefore not available to marine life. If this occurs, TBT might not be as much of a threat as the tests indicate in the lab.

One of the arguments of supporters of TBT is that even though we have seen high levels of it, we have not seen declines in marine life. Could both of you comment, or your aides, is there evidence of decline in marine life in your State due to TBT levels, or are you confident that TBT has affected marine life, or is it still open to question?

Ms. SMITH. I think the general conclusion, and I think this is borne out by Dr. Huggett, is that we have not seen the decline and it is still open to question. I think earlier in his testimony Dr. Moore talked about wanting to be in a position to prevent any Draconian consequences from the use of the chemical. And our concern is that we simply not wait until we see the sign of some Draconian consequences. So we don't have the evidence at this time of the adverse impact on the marine resources, but we see the potential there, and we are very concerned about that potential.

Senator MIKULSKI. Dr. Brown, you know we have had a rough time in our oyster industry this year.

Dr. BROWN. Yes. I know. Well, I would say that we don't have the data yet that says our declining oyster industry is the result of TBT. That we cannot say for certainty. I would love to find that the oyster industry returned when we took this action, for any reason, including this action. We do know that TBT, though, is available, bioavailable, to living things in the bay.

I would ask Mr. Bundy to just comment on that briefly.

Mr. BUNDY. It is true that tributyltin, TBT, does change in form and can be bound up and remain for a great deal of time in the sediments. But there is a period of time from when it is released from the hull of a boat, it adheres to a particle, settles out, and becomes bound into the sediment where it is available and can be toxic to marine organisms. The evidence that was found in France in the Arcachon Bay, the evidence that has been found in laboratories throughout the United States indicate that levels that are currently being found in the Chesapeake Bay and elsewhere across the Nation are levels that are equal to that which in the laboratory causes problems from mortality to other kinds of biological reactions. Therefore, it is the potential and the possible threat and impact to resources that causes us to take action to prevent those kinds of things from occurring in the bay.

Senator MIKULSKI. Well, I think that really completes the questions that the committee and I had. We would like to thank the panel for a very informative and thorough testimony. Again, we would like to congratulate you on your own initiatives.

This committee, the Subcommittee on Environmental Protection of the Senate Committee on Environment and Public Works, stands adjourned.

[Whereupon, at 12:25 p.m., the subcommittee was adjourned.]

[Statements and other material submitted for the record follow:]

STATEMENT OF
JOHN A. MOORE
ASSISTANT ADMINISTRATOR FOR PESTICIDES
AND TOXIC SUBSTANCES
SUBCOMMITTEE ON ENVIRONMENTAL PROTECTION
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS
UNITED STATES SENATE
WASHINGTON, D.C.

APRIL 29, 1987

Good morning, Mr. Chairman and members of the Subcommittee. I am pleased to appear before you to discuss the actions which the Environmental Protection Agency (EPA) and others have underway to address the Agency's concerns for the risks from the use of tributyltin (TBT) compounds in antifouling paints. These activities are designed to provide the Agency with information which should be useful in making future regulatory decisions in this complex area.

Under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), EPA is required to balance risks and benefits in reaching regulatory decisions on the registration and use of pesticides. Through the Special Review process, the Agency collects risk and benefit information on a pesticide to determine whether its use causes unreasonable adverse effects on human health or the environment.

The Special Review process ensures that EPA assesses the risks which may be posed by pesticides, as well as the benefits from the use of those pesticides, in an open and responsive manner. Through the issuance of notices and support documents, EPA publicly sets forth its position, and invites pesticide registrants, Federal and state agencies, user and environmental groups, and any other interested persons to participate in the Agency's review of pesticides which we think might pose unreasonable risks. The scientific bases for EPA's proposed decisions are reviewed by the FIFRA Scientific Advisory Panel. If the Agency determines that the risks appear to outweigh the benefits, the Agency can initiate action under FIFRA to cancel, suspend and/or modify the terms and conditions of registration.

On January 8, 1986, the Agency announced the initiation of a Special Review of all pesticide products containing TBT compounds used as additives to antifouling paints. These paints are applied mainly to boat and ship hulls to inhibit the growth of certain aquatic organisms. Based upon a review of laboratory and other available data, it was concluded that the use of these compounds in antifouling paints might result in significant exposure to nontarget (other than the intended pest) aquatic organisms at concentrations resulting in acute and chronic toxicity.

As part of its activities, the Agency evaluated bioassay studies, which indicate that TBT compounds are highly toxic, even at very low levels (part per trillion (ppt)), to nontarget marine and freshwater aquatic organisms. To date, the most sensitive species appear to be in the phyllum mollusca, which includes snails, clams, mussels, and the like. EPA staff also reviewed numerous aquatic toxicity studies which indicate that TBT compounds can cause chronic hazards, such as anatomical abnormalities and growth effects in nontarget aquatic organisms.

Environmental monitoring data measuring TBT concentrations in the Great Lakes and U.S. coastal waters were compared to concentration levels which are known from laboratory toxicity studies to cause adverse effects. Since environmental concentrations of TBT were detected at levels exceeding laboratory toxicity estimates for nontarget organisms, the Agency determined that the initiation of a Special Review on TBT antifouling paints was appropriate.

The United States is not alone in its efforts to restrict the use of TBT antifouling paints. Since 1983, France has prohibited the use of TBT paints for all boats less than 25 meters in length. Taking a different regulatory approach, Great Britain in January 1986 banned the use of TBT antifouling paints with greater than specified threshold values of organotin content.

There are alternatives to TBT. Copper is the main one used in antifouling paint formulations, and it is effective against the same organisms. A major disadvantage of the copper-based paint is its tendency to be corrosive to metal, especially aluminum. Approximately one-half of the TBT antifouling paints marketed contain both copper and TBT as active ingredients. Several other innovative alternatives exist, some of which are still in the research stage, while others have been commercialized only recently, and thus have not been fully tested in the market place.

In initiating the Special Review, the Agency identified significant gaps in the data bases supporting the registrations of the TBT compounds. In order to obtain data for use in assessing the possible risks, EPA began issuing data call-in (DCI) notices to all registrants in July 1986, levying extensive data requirements pursuant to the Agency's authority under FIFRA section 3(c)(2)(B). One of these requirements is the release-rate test, which under laboratory conditions measures the rate at which TBT is released from a painted surface (such as a boat hull) after immersion in water. The protocol for this test was developed in cooperation with the American Society for Testing and Materials (ASTM). The results from these tests are under review and will assist the Agency in determining daily release rates and 6-week cumulative release rates for different TBT paint products. This information in turn will be useful in determining whether the release rate will be a meaningful criterion for measuring TBT exposure.

The Agency does not yet know how many registrants will submit the required data. Based on the rate of compliance with the DCI so far, it appears that a significant portion are unwilling to bear the costs for the required testing.

Specifically, the Agency has summarized the response to date to the July 1986 DCI:

- 21 of 61 registrants, representing 12 manufacturing-use products and 125 of 359 end-use products, committed to develop the required data.
- 20 registrants voluntarily requested the cancellation of 82 paint formulations.
- 30 registrants, holding 139 registrations, have not responded to the DCI, and therefore have been sent Notices of Intent to Suspend.
- 10 of 21 registrants who originally committed to meet the DCI requirements, but have not submitted release-rate data, have been issued Notices of Intent to Suspend for over 70 products.
- To date, only about 10 registrants, representing approximately 40 formulations have submitted release-rate data, and have thus far timely complied with the release-rate data requirement of the July 1986 DCI.

Significantly, the total number of products voluntarily cancelled, or subject to notice-of-intent-to-suspend actions is nearly 300, or about 80 percent of the 359 affected TBT products. It should be noted, however, that only about one-half of the annual volume of production is accounted for by these nearly 300 products. Moreover, it would be reasonable to assume that over time the remaining registrants would increase production to meet any resulting supply gaps.

In addition to the TBT release-rate data, the Agency also required information on product chemistry, ecological effects, environmental fate, worker exposure, quantitative usage, and efficacy of TBT products. While some of these data can be generated in a short time period, and have already been submitted to the Agency, many of the studies relating to environmental fate, ecological effects, and worker exposure may require from two to four years to complete.

EPA is faced with extremely difficult questions as it assesses the risks from TBT compounds. Currently, the Agency is reviewing comments submitted by the registrants, users, and other affected parties in response to the initiation of the Special Review. The major issue raised in these comments pertains to the extent to which TBT binds to particulates in the water and to sediments, and thereby reduces its bioavailability to aquatic organisms.

Contrary to the claims contained in some of the comments submitted by the registrants, however, TBT does not bind to organic matter to the same degree as copper. With TBT compounds, the extent of such binding is highly dependent upon the carbon content of the particulate matter, and thus can vary substantially by location. Moreover, it appears that in waters which have turbidity levels normal for viable marine habitats, the bound TBT would constitute only a small fraction of total TBT content.

There are also significant questions concerning the sublethal effects of TBT exposure on the reproduction and growth of nontarget aquatic organisms. These issues will be understood only when the long-term environmental fate and ecological effects studies have been completed and reviewed by the Agency.

The Agency has also studied environmental levels of TBT by taking samples in the Chesapeake Bay. The concentration of TBT has been measured in harbors and marinas, as well as downstream from these locations. During the 1986 summer boating season, water samples were collected weekly by the Chesapeake Bay Liaison Office. EPA's Environmental Research Laboratory in Gulf Breeze, Florida analyzed the water samples for TBT and dibutyltin (a degradation product of TBT). In his testimony presented later today, Mr. Seif will discuss the results of this analysis.

Sampling activities have been conducted at the state level also. Maryland, Virginia, and California have been sampling surface waters in order to determine TBT levels in their surface water ecosystems. In addition, the Navy has sampled waterways for TBT in many locations throughout the U.S. for the past several years. These data have been received by the Agency and are being evaluated as part of the TBT Special Review.

In order to generate localized estimates of TBT usage from the production and sales data obtained through the July 1986 Data Call-In, the Agency has contracted for a nationwide survey of private boatyards. Among other things, the survey has collected information on how often boats are painted, how many coats of paint are typically applied, and the relationship between type of vessel and type of antifouling paint applied. A final report of the survey results is due in early Summer 1987.

Rather than wait until all of the data are in hand before taking regulatory action, the Agency will take interim measures, should the results of preliminary analyses so warrant. In order to address the risks posed by environmental exposure to TBT, I currently envision a two-phase regulatory process. Based upon the results of the Agency's recent water sampling activities and the information obtained from the release-rate test data currently under review, EPA will be in a position to make a preliminary regulatory decision by Fall 1987. While it would be premature to speculate on specifics at this time, these measures will most likely involve the initiation of actions to restrict or cancel, the registrations of antifouling paints, based on release-rate or other criteria as appropriate. Concurrently, as a condition of continued registration, the Agency might require remaining registrants to conduct intensive monitoring of TBT concentrations in the environment. Subsequently, as the long-term ecological effects and environmental fate data become available over the next four years, and as additional monitoring data are accumulated, the Agency might refine its interim decision, including the imposition of more stringent restrictions, if necessary.

Complementing the actions of EPA's Office of Pesticide Programs, the Agency's Office of Water (OW) is developing water quality criteria with regard to TBT. Water quality criteria are developed under Section 304(a) of the Clean Water Act and contain two essential types of information: (1) discussions of available scientific data on the effects of pollutants on public health and welfare, aquatic life, and recreation; and (2) the maximum level of pollutants in water which will generally ensure water quality adequate to support a specified water use, based either on quantitative or qualitative assessments. These criteria are based solely on data and scientific judgments on the relationship between pollutant concentrations and environmental and human health effects. Criteria recommendations are not regulatory in nature and do not reflect consideration of economic or technological feasibility.

The process for deriving a water quality criterion recommendation is essentially the same as for a rulemaking--recommendations are first peer-reviewed within the Agency, then subjected to public review and comment, with final recommendations issued upon consideration of public comments. The Agency follows a prescribed set of guidelines in deriving criteria. These guidelines establish a minimum required data set, and define the methods for assessing the data. Generally, it requires about two years to develop a criteria document.

In an effort to fill the gap between the large number of pollutants and the limited number of criteria that can be derived, OW is initiating the development of water quality advisories. An advisory is designed to be a low-cost, more efficient way to compile and analyze existing data available to the Agency, and to provide such information to the States more quickly than is possible through the criteria development process. Once issued, advisories can also be updated much more quickly than criteria documents.

The intention is that advisories be used in the same manner as water quality criteria for the establishment of water quality standards. Because of the process by which they are developed, and given that advisories are derived from fewer data, the confidence level is less than that for a standard.

Since a signficant amount of new data may result from the TBT Special Review, OW has decided to delay the issuance of its proposed criteria document until such additional data can be analyzed. Were a standard to be issued, the criteria recommendations which would be put forth are on the order of:

Freshwater:

Criterion Maximum Concentration (acute) 150 ng/l (parts per trillion)

Criterion Continuous Concentration (chronic) 20 ng/l

Saltwater:

Criterion Maximum Concentration (acute) 240 ng/l

Criterion Continuous Concentration (chronic) 30 ng/l

It must be noted, however, that the additional chronic data will not be available for another 2-4 years. Depending upon the outcome of the subsequent analysis, these criteria recommendations might remain the same or be changed. In the interim, OW expects to issue its available information on TBT in the form of a water quality advisory within about 90 days.

In view of the coordinated effort currently under way by the Agency to reduce TBT exposure to acceptable levels, there is no call for additional legislation, such as that provided in the proposed "Tributyltin-Based Antifouling Paint Control Act of 1987." Our ability to act has been constrained, not by insufficient statutory authority, but by the lack of adequate data necessary for making scientifically sound decisions.

The proposed legislation mandates the use of a steady-state release rate as the sole regulatory criterion. Until EPA scientists review all of the release-rate data, however, there is no rational basis for choosing among various possible regulatory criteria, let alone determining a scientifically relevant release-rate value. Moreover, the bill raises potential legal issues concerning its relationship to existing FIFRA Section 6 suspension authority, and to the indemnification and disposal provisions in FIFRA Sections 16 and 19.

Apart from technical considerations regarding the bill, EPA strongly opposes, on general principle, the use of chemical-specific legislation to supercede the regulatory process previously established by Congress under FIFRA. The issues typically raised over the course of any given special review are of a highly technical nature, and as such are not amenable to resolution by the legislative process.

Let me reiterate that the Agency has issued DCI notices to all TBT registrants, levying extensive data requirements. The DCI notice includes data requirements for product chemistry. ecological effects, environmental fate, worker exposure, quantitative usage, and product efficacy. Scheduled data submissions range from 90 days, for data such as quantitative usage, to as long as two to four years for long term studies, such as aquatic food chain field studies. Receipt of data will continue into 1990. Failure to comply with DCI requirements will result in issuance by the Agency of a Notice of Intent to Suspend the affected product registration. Last but not least, the immediate effect of the July 1986 DCI itself has been a likely reduction in the number of products which can be marketed by approximately 80 percent. Such a reduction would significantly reduce the adminstrative burden, and thereby enhance the Agency's ability to make its regulatory decisions on an expedited basis.

As you can see, the Agency shares the Subcommittee's deep concern about the risks posed by TBT. We are working as rapidly as possible with state and Federal agencies, as well as with industry, to develop the data necessary to reach a scientifically sound decision. In the interim, we will take any regulatory action necessary to reduce the environmental risks posed by TBT antifouling paints. I am confident that the regulatory process is the appropriate vehicle for ensuring the protection of our nation's aquatic resources.

I will be happy to answer any questions you might have.

Mr. Chairman and members of this Committee on Environmental Protection, my name is Arthur Sheldon. I am the Director of Safety and Environmental Affairs for M&T Chemicals Inc. where I have been employed for more than 30 years. I would like to thank you and the members of this committee for the opportunity to present this testimony on Senate Bill S.428 entitled "Tributyltin-Based Antifouling Paint Control Act of 1987".

M&T is the major manufacturer of many different organotin-based products including tributyltins for antifoulant paints. It should be noted that we do not manufacture antifouling paints but rather provide the active organotin ingredients to the leading paint manufacturers worldwide.

Over the past 25 to 30 years M&T has conducted numerous studies with these chemicals to better understand their potential effects upon man and his environment. These studies have included mammalian, aquatic and avian toxicology, environmental chemistry and medical surveillance of manufacturing employees. The accumulated data clearly demonstrate that these chemicals are safe to use in their intended applications. Mr. Chairman, we urge you not to restrict the use of these chemicals while EPA is evaluating the existing data as well as data from studies in progress.

Note: Attachments to this statement have been retained in committee files.

General Background

Organotin chemicals as a category comprise a broad range of chemicals with entirely different uses. Within this general category there are three basic subgroups which include tri-organotins, diorganotins and monoorganotins.

The triorganotins are important chemicals in that they are used as pesticides to control a number of different crop destroying insects and fungi. Among the triorganotins is tributyltin oxide which is used in antifouling paint formulations. It should also be noted that tributyltin oxide is currently under consideration by the World Health Organization as a strong candidate for the control of the parasite which causes Schistosomiasis. This endemic disease, which is most prevalent in developing nations, is second in severity and debilitation only to malaria.

The triorganotins are classified as pesticides and are therefore registered with the U.S. Environmental Protection Agency (EPA). To register these chemicals, EPA requires extensive toxicological testing. Only after exhaustive and thorough review of the results of these and other relevant studies by EPA are these products registered and marketed.

Diorganotins are commonly used as indirect food additives in plastic packaging and, in one case, as an animal drug. Monoorganotin chemicals are also used as indirect food additives. These applications of di- and monoorganotins require the approval of the Food and Drug Administration (FDA) which mandates the development of extensive toxicology and other relevant data to satisfy the Agency that the proposed use is safe.

Toxicity of Organotin Compounds

The toxic effects of organotin compounds on a particular organism is highly dependent upon whether it is a tri-, di-, or monoorganotin compounds. The triorganotins are typically the most toxic species while the di- and mono- exhibit progressively less toxicity. One group of organotin chemicals---butyltin oxides---provides an excellent example of this relationship. Using a conventional measure of acute toxicity, the dibutyltin oxide is 4-5 times less toxic than tributyltin oxide, and the monobutyltin hydroxide is 40 times less toxic than the dibutyltin compound.

Related to the relative toxicities of the different subgroups, is the rate at which the decay process proceeds. **Unlike other organic compounds which are persistent in humans and in the environment for many years, triorganotins undergo rapid decay or degradation.** Triorganotins quickly degrade to diorganotins, then more slowly to monoorganotins. The final degradation step is to inorganic tin which is classified by FDA as Generally Recognized as Safe. The method and rates of degradation differ between humans and the environment. The endpoint, however, is the same in each case---the compound decays to a less toxic species.

It is of paramount importance to recognize the profound differences in the toxicity of these organotin subgroups and their rate of breakdown in order to understand the effects of organotins in man and his environment.

Human Health Effects of Organotin Compounds

Organotin chemicals have been tested for many years in a number of acute and chronic animal studies in a continuous effort to learn as much as possible about the potential human health effects of these chemicals. [illegible] date there is no evidence that organotins are [illegible], mutagenic, teratogenic or cause reproductive health [illegible] As a class of chemicals they have been subjected to extensive testing. To date, eight individual 2-year mammalian dietary studies have been successfully completed with organotin chemicals. In addition, there are at least an equal number of teratology, mutagenicity, and reproductive studies, all of which have been performed and submitted to either EPA and/or FDA for review. [illegible] every case, the government agency involved in the [illegible] process found that the organotin was suitable for its [illegible] These products include fungicides (EPA), insecticides (EPA), and food additives (FDA).

From our experience with the production and use of tributyltin compounds we have learned that the acute health effects resulting from exposure are limited to skin, eye and possibly mucous membrane irritation with no reports of adverse health effects from chronic exposure. Our periodic medical review of production workers have included a full battery of diagnostic tests and hands-on examinations of each employee, as well as a biostatistical analysis of the medical data. **No long term medical problems have been detected in the work force that can be attributed to repeated low [illegible] exposures to tributyltin compounds.**

We believe that the lack of chronic effects is due to the rapid metabolism and excretion of organotin compounds from the body. The biological half-life has been reported to be approximately 4 to 7 days in animal studies. This is extremely short by comparison to some of the halogenated organics or other chemicals which have a half-life measured in years.

Biological monitoring of humans confirms the rapid excretion of organotin compounds cited in the literature. Measurements of organotins in urine of our employees shows that degradation of organotin compounds is rapid following acute exposure. This degradation process was clearly demonstrated in a case which occurred in 1986 when a woman accidentally ingested a few grams (2.5-3.5) of tributyltin oxide. From the first urine sample we learned that only the less toxic forms, di- and mono- organotins were present. There was no tri organotin species present. Organotins in her body quickly decreased until it reached background levels only six days post exposure. In addition, there was no clinically detectable evidence of adverse health effects.

Effects of Tributyltins on the Aquatic Environment

In the environment, the degradation pattern of organotins occur in the same manner as in humans. The actual rate of breakdown is dependent on many factors such as the amount of sunlight, temperature of the water, suspended particles in the waterways, pH, etc. Field studies have shown the half-life in water to range from 6-19 days. As with humans, the toxicity to aquatic organisms of the di- and mono organotins is less than the tributyltin compounds.

Aquatic laboratory studies generated by M&T and reported in the literature show that the triorganotin antifouling chemicals are toxic. This is an expected response for a biologically active chemical. The acute toxicity of these compounds generally ranges between 1 and 40 parts per billion. Laboratory experiments, however, while of value in determining the range of toxicity for a chemical do not address the question of the potential toxic effect in a true ecosystem. Laboratory experiments do not reflect the many complex interactions present in the environment including decay or degradation. For these reasons it is extremely difficult to use only laboratory data to predict the effect on inland waters.

Six years ago, before there were any concerns raised about the use of these chemicals M&T decided to study the potential effects resulting from possible extensive and increasing use of organotins in antifouling paints. At that time we contracted to perform a mathematical modeling study based on New York Harbor and Chesapeake Bay. In the course of these studies we assumed that 100% of the vessels in these harbors would be coated with triorganotin containing antifouling paints. The model took into account hydrolysis, bacterial degradation, photolysis, volatilization, absorption on soil and, and of extreme importance, the decay rate of these chemicals in the environment. These environmental chemistry parameters were derived from either M&T data or other previously published reports.

A report of this harbor model study which is attached in [redacted] 1 was reported at the Oceans '85 Symposium and then [redacted]. The study concluded that there would not be an adverse effect on marine life if all of the ships in New York Harbor or Chesapeake Bay used organotin paints.

It is interesting to note the photographs from actual field tests of fouling on plates coated with triorganotin copolymer antifouling paints which are attached in Appendices 2, 3 and 4. These photographs dramatically indicate a diverse and abundant growth of marine life including barnacles and algae growing up to the very border of the surface with the triorganotin paint.

These paints protect the coated surface by repelling growth but still allow prolific growth in the immediate environment without the slightest hint of adverse effects on adjacent marine organisms. This observation underscores the need to better define the potential effects of these chemicals on non-target organisms.

Summary

In March of 1986 M&T responded to EPA's request concerning the Data Call In on tributyltin antifouling paints of January, 1986. In Appendix 5 we have attached a copy of M&T's March 6, 1986 response to EPA. This letter clearly illustrates the extent of toxicological and other testing currently in progress.

M&T estimates that the three EPA Data Call Ins related to triorganotins will cost approximately 5-7 million dollars. In general these studies consist of both chronic mammalian and long term aquatic toxicity studies. The exact cost can only be determined when EPA completes its review of 27 different protocols on aquatic and environmental fate studies recently submitted.

Over the years M&T has been concerned with very difficult questions concerning health and environmental issues related to organotins and has independently sponsored research to provide some of the answers. We have continually worked with both industry and government leaders in conducting testing and developing extensive data on numerous organotins. These efforts are continuing as part of the recent EPA Data Call In for tributyltin compounds in antifouling paint formulations.

The available data however indicate that tributyltins do not have deleterious long term effects on man or the environment. While the findings of laboratory studies would appear to indicate a potential threat to marine life, there have been no such adverse environmental effects substantiated by the scientific community.

M&T is committed to performing all the EPA required environmental studies with these chemicals. It is only after thorough review of these data that EPA can make a responsible technical judgement as to the true effects of these chemicals in the environment.

It should also be noted that the antifouling paint formulations containing organotin copolymers represent the current state of the art. These formulations were originally developed as a response to the energy crisis. An additional benefit of the copolymer paint formulation is that the amount of organotins released to the environment is significantly reduced as compared to the original free association paint formulation.

Conclusion

M&T strongly recommends that the Senate not act to restrict the use of organotins in antifouling paints. This conclusion is based upon the following:

1) The published scientific data that exists clearly demonstrate that these chemicals are safe to use in their intended applications.

2) Unlike other organic compounds which are persistent in humans and in the environment for many years, triorganotins undergo rapid decay. The final degradation step is to inorganic tin which is classified by the FDA as Generally Recognized as Safe.

3) To date there is no evidence that organotins are carcinogenic, mutagenic, teratogenic, or cause reproductive health effects.

4) Based on our 30 years of manufacturing experience, no long term medical problems have been detected in the work force that can be attributed to repeated low level exposures to tributyltin comounds.

5) M&T is committed to and is actively performing all the EPA required environmental studies with these chemicals.

Mr. Chairman we thank you for this opportunity and would be pleased to answer any questions you may have.

The Effects on the Marine Environment of the Chemical, Tributyltin

By

Robert J. Huggett, PhD

Testimony before the Subcommittee on Environmental Protection of the Senate Committee on Environment and Public Works

April 29, 1987

My name is Robert Huggett and I am a Professor in the School of Marine Science of the College of William and Mary. I am also an Assistant Director of the Virginia Institute of Marine Science and Head of the Division of Chemistry and Toxicology at the Institute. The Institute is part of the College of William and Mary. The Institute is mandated by the Code of Virginia to provide advice to the regulatory agencies of the Commonwealth, and to the users of Virginia's waters, on matters of importance to the well being and health of the Chesapeake Bay and contiguous waters. To carry out this mandate we perform the research needed to understand and evaluate existing or potential problems. It is within this context that I have been involved with the tributyltin (TBT) issue for the past four years.

Tributyltin is a toxic chemical, which is why it is used as a biocide in antifouling paints, applied to the bottoms of boats and ships. It leaches or diffuses out of the paint film forming a very thin layer of highly concentrated TBT in the waters surrounding the vessel's hull. Fouling or nuisance organisms, such as barnacles, are killed or repelled when they encounter this layer thus protecting the vessel from the deleterious effects of the fouling community. It further diffuses into the adjacent waters where other plants and animals are exposed. It is this aspect of the issue which has caused concern in the scientific community of this country and of several countries in Europe as well.

In the latter part of the 1970's, a significant decrease in the abundance of Pacific oysters, Crassostrea gigas, was noted in Arcachon Bay on the Atlantic Coast of France. Additionally, the occurrence of shell malformation, which had been rarely observed before, increased to affect 80% to 100% of the animals. In 1980, TBT coming from recreational boats in the vicinity of the oyster beds was suspected to be the causative agent. In 1982, the French banned the application of antifouling paints containing TBT to hulls of all boats less than 25 meters (∿82 feet) with hulls made of alloys being excepted. Since that period, French scientists have noted a decrease in organotin concentration in waters from Arcachon Bay, a significant increase in oyster production and a dramatic decrease in shell deformation.

The British have likewise observed impacts on their oyster populations inhabitating areas which experience high boating activities. Their scientists drew conclusions similar to those derived in France. In January of last year, the British government introduced regulations to prevent the retail sale of TBT paints which leach at high rates by allowing only the sale of copolymer paints which contain 7.5% or less total tin or 2.5% total tin in other paints. They also set a "safe" water target concentration of 20 ng/l (pptr, parts per trillion) as a goal they would like to achieve to protect their marine resources. On February 26th of this year, officials of their Department of the Environment issued a letter (copy enclosed) stating that, "You will recall the Minister For the Environment Mr. Waldegrave announced in July 1985 (copy enclosed for ease of reference) (sic) measures for dealing with the problems arising from the use of antifouling paints containing organotin compounds on small craft. It is now apparent that those measures have not brought the problem under control and that our water quality target set in 1985 is not strict enough to protect the most sensitive sectors of the marine environment." They further state that they intend to reduce the target concentration to 2 ng/1 and ban the supply of TBT based antifouling paints for use on small boats.

Efforts to determine the effects of TBT on marine and estuarine species have been hampered by the inability, until recently, to chemically analyze the concentrations to which the test animals were being subjected. This was partially due to the chemical structure of TBT which imparts both an inorganic and organic nature to the compound thus making quantitation difficult and the fact that toxicity was exhibited at lower concentrations than normally encountered in toxicity tests. The TBT exposure levels had to be estimated. Because of unavoidable losses of the toxicant during the tests due to sorption, degradation, etc., the actual toxicities may have been much greater than predicted. Recently, analytical techniques have improved and more accurate and precise data are being generated.

The biological effects induced by TBT on marine and estuarine organisms, range from acute to chronic. At concentrations near or below 1,000 pptr, some species are killed. For instance the larvae of the Eastern oyster, _Crassostrea virginica_ and the hard clam, _Mercenaria mercenaria_, succumb to concentrations of approximately 1,000 pptr when exposed for 48 or 96 hours. Mortality of 50% of the larvae of mussels, _Mytilus edulis_, was observed when exposed to 100 pptr TBT for 15 days. There is some laboratory and field evidence that TBT concentrations of less than 50 pptr cause the female dogwhelks, Nucella lapillus, to grow a penis-a phenomenon known as "imposex." Under laboratory conditions, female European oysters, Ostrea edulis, show a prepensity toward maleness (i.e. conversion of females to males) at exposure concentrations of several hundred parts per trillion TBT.

Some of the species mentioned are not native to the Chesapeake Bay but most are indigenous to some of the waters in our country. Therefore it is important to compare the TBT concentrations found in our nation's waters with those thought to impact the various species. Since the major source of TBT to the marine environment is from antifouling paints, it is logical to expect that areas with high boating activities would have higher concentrations than those with lesser boating traffic. This is the case. Harbors with large marinas and low flushing rates have been shown to contain TBT concentrations sometimes at or exceeding 1,000 pptr. Such concentrations have been found in Virginia, Maryland and California (it should be noted that some of our coastal states have had little or no TBT monitoring). My Institute has been monitoring several tributaries of the Chesapeake Bay which have marinas for over a year. The general trend is for concentrations near these facilities to be between 20 and 50 pptr with one particular area to be usually over 100 pptr. More open waters, such as Hampton Roads contain concentrations between 2 and 20 pptr. Similar concentrations have been found in the Maryland portion of the Chesapeake Bay. Expectedly, in the vicinity of shipyards which apply or remove TBT paints, concentrations are elevated relative to further upstream or downstream.

Tributyltin is a relatively non-persistent chemical. In natural waters it degrades to less toxic compounds (dibutyltin and monobutyltin) with a half life of a few days to a few weeks. The TBT degradation rate in sediments is not as well understood as when the material is in the overlying water. Sediment half lives of up to five months have been reported. TBT does degrade in the environment. But, since elevated concentrations are found in waters which experience high boating activities, the degradation is not rapid enough to keep the TBT below apparent toxic levels.

Data presented at a TBT Evidential Hearing held on November 5 and 6, 1986 by the Virginia Department of Agriculture and Consumer Services, indicate that the majority of TBT entering Virginia's waters comes from recreational vessels. The estimate, although somewhat crude, is that approximately 70% of the biocide comes from recreational craft, 28% from large commercial vessels and 2% from the U.S. Navy. The recreational vessels are dispersed throughout the tributaries of the Bay and expose a much higher proportion of the Bay's biota than do vessels in the other sectors. These were the basic reasons that the Virginia law was designed to stringently control the use of TBT on pleasure craft. Other speakers will address Virginia's action in detail.

Existing scientific evidence indicate that TBT can be concentrated by marine and estuarine organisms. Oysters collected from the Hampton Roads area of Virginia were analyzed by the U.S. Navy for total organic extractable tin and were found to contain mg/kg quantities (ppm, parts per million). Research at my Institute has found that oysters from a previously thought clean river, the Rappahannock, contain approximately 50 μg/kg (ppb, parts per billion) TBT. Oysters, and presumably clams, have a very limited ability to metabolize TBT relative to finfish. Therefore they have the potential of accumulating the material to levels which may eventually prove harmful to human consumers. A safe concentration in seafood for human consumption has not been established. Hopefully it will not be found to be harmful to human consumers at concentrations found in the seafood. But, at this time, it is an open question which deserves serious attention.

In summary, TBT is a toxic chemical. It is entering the marine and estuarine waters of our country from the numerous vessels which use it as a biocide in antifouling paints. It is extremely effective for its intended purpose of keeping fouling organisms off hulls. For this reason, its future usage will likely increase. Unfortunately, it is now present in some of our harbors and estuaries at concentrations which I believe harm nontarget plants and animals.

In Virginia's waters, most of the TBT is coming from the recreational fleet. As previously mentioned, we estimate that approximately 70% comes from this sector. Since Virginia has one of the nation's largest commercial maritime industries as well as the Norfolk Naval Complex, the percent contribution of TBT from recreational vessels in most other states will be even higher. It is logical, therefore, to target these boats for potential TBT controls. In Virginia we have banned the sale and use of TBT on vessels under 25 meters with aluminum hulled boats being excepted (aluminum hulls suffer severe corrosion when the major antifouling alternative, copper, is applied). The owners of these boats have alternative paints even though the alternatives are not as effective for as long as TBT.

Commercial vessels, by definition, must make a profit in order to stay in business. Paints which protect the hulls for longer periods of time offer an obvious economic advantage. This is a compelling reason for allowing them to use TBT. However, if they are to use TBT paints, only those with the lowest leaching rates should be allowed.

The United States Navy should, I believe, be given priority if anyone is allowed to use TBT. Fleet readiness, fuel and drydock savings are the reasons for my conclusion. As with commercial vessels, only the lowest leaching paints should be allowed.

I do not believe that we know, at this time, the "safe" concentration of TBT in our nation's waters. We do know that it is very low. We must be aware that the actions taken this year, to minimize the input of TBT to our waters, may need to be changed in the future as new scientific data become available.

I commend this committee for holding this hearing. I support proposed actions allowing only low leaching paints and would further support a more stringent regulation, banning the sale and use of TBT antifouling paints in the recreational sector with aluminum vessels being exempted.

Huggett.

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26 February 1987

Dear Sir/Madam

ANTIFOULING PAINTS

You will recall the Minister for the Environment Mr Waldegrave announced in July 1985 (copy enclosed for ease of reference) measures for dealing with the problems arising from the use of antifouling paints containing organo tin compounds on small craft. It is now apparent that those measures have not brought the problem under control and that our water quality target set in 1985 is not strict enough to protect the most sensitive sectors of the marine environment. Indeed, we expect to make proposals shortly which would, in effect, reduce this target by a factor of 10. In addition work in Scotland has shown that a severe problem has arisen there from the use of similar products on fish farming equipment. Not only are there severe environmental problems in and around fish farms but farmed salmon has been found to be contaminated.

All of this has led the Government to the view that further action is well justified and it is in everyone's interest to announce this view and to act as quickly as practicable. I attach to this letter a copy of the text of a statement which Mr Waldegrave made to Parliament on 24 February which sets out briefly the Government's intentions.

This letter and its enclosures are sent to you so that you have an indication of the Government's intentions. You are welcome to comment at this stage, but there will be a short formal consultation period on the draft regulations after the notice of intent is published in the official Gazettes. I will contact you again at that time with the draft regulations.

Yours faithfully

J. Vosser

Mr J L Vosser

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STATEMENT OF
REAR ADMIRAL MYRON V. RICKETTS, U.S. NAVY
DEPUTY COMMANDER FOR DESIGN AND ENGINEERING
NAVAL SEA SYSTEMS COMMAND
BEFORE THE
ENVIRONMENTAL PROTECTION SUBCOMMITTEE OF THE
SENATE COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

29 APRIL 1987

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Good morning, Mr. Chairman and members of the Committee. I appreciate the opportunity to present my views on tributyltin paints as used by the Navy and the effects on the marine environment.

The Navy, for many years in the United States, has been engaged in the formulation and research of antifouling paints, including organotin paints. Specifically, we have been formulating organotin paints since 1970 and we have been conducting research into the effects of tributyltin paints since 1976. It is only recently that other organizations have joined the effort.

From the very beginning, the Navy has been concerned with the effect on the environment and the safety of utilization, and has taken reasonable steps to minimize effects which could occur to the environment. Our safety procedures are standardized and are followed for other substances as well as application of tributyltin paints.

We have concluded that the tributyltin paint formulations specified by the Navy constitute minimal hazard to the environment, and we have reached this conclusion after over 10 years of research and development. If all the ships in the Navy were painted with the Navy-specified tributyltin paints, our part would be less than 2 percent of the tributyltin leached into U.S. coastal waters today.

It is also important to understand the differences in requirements for tributyltin paints between steel-hulled and aluminum-hulled ships, and also measurement techniques.

In our paint formulation for steel-hulled ships, we use a combination of tributyltin and copper. Copper is added to reduce the amount of tributyltin necessary for effective antifouling. These paints are totally satisfactory for use on steel-hulled ships.

In the case of aluminum-hulled ships, copper has the potential to attack the hulls by galvanic corrosive action. Therefore, antifouling paints for aluminum-hulled ships are restricted to the tributyltin variety. We have no identified alternative.

There have been articles on so-called teflon paints which are advertised to have very slick surfaces, such that sea growth cannot attach to the hull. We tried those paints and they didn't work. I personally jumped into the water with a snorkel and examined a hull with this paint and can testify that the sea growth rapidly formed and was persistent. The hull was only slightly easier to clean than with other non-antifouling paints.

With respect to measuring techniques, the EPA, the Navy and others obtain similar results for organotin levels in the water. That is, we all get the same answer when we independently measure the same water. However, when we discuss leach rate, which is the rate at which organotin leaves the painted hull, the Navy method and EPA method differ, and for good reason. The Navy chooses to measure the leach rate from flat plates sitting essentially in still water because this closely represents what will actually be leached into the water by ships' hulls. In the Navy methodology, we commence measuring the leach rate after a 30-day stabilization period. This period is needed to duplicate natural environmental factors. This is a slow and relatively expensive method. The EPA paints a cylinder which is then rotated at 60 rpm. The results are repeatable and quickly obtained. However, they do not represent actual leach rates from ships into the water. The scrubbing action of the water as it rapidly passes over the painted rotating cylinder is the reason leach rates are higher. For example, a relatively soft paint will have a leach rate significantly higher on the rotating cylinder, whereas a hard paint will raise the leach rate only slightly because the scrubbing action affects the soft paint more. The Navy has no problem with the EPA measurement technique as long as the values used permit the Navy to continue utilization of the low leach rate paints which we advocate.

The balance of my testimony will discuss in more detail our experience in dealing with tributyltin paints, the Navy's research and development program, costs related to use of these paints and, specifically, what the Navy recommends.

I. NAVY EXPERIENCE

The Navy has over 20 years of experience with organotin paints. The first use of these paints had been on aluminum hulls because of the unique compatibility of tributyltin (TBT) paints with aluminum. Copper-based paints are incompatible with aluminum and can lead to pitting and hull degradation by corrosion attack. During the sixties, many steel-hulled ships were painted with TBT paints. All of these earlier applications involved TBT compounds physically mixed into the paint which are sometimes called "free association" paints.

In the seventies, the Navy began the development of Navy formula TBT polymer paint and the evaluation of commercially available TBT paints. The energy crisis of that period prompted the commercial development of self-polishing co-polymer TBT paints which claimed a surface smoothing capability as a result of surface renewal by reactions with water. The Navy recognized that self-polishing and ablative paints had the potential to provide the needed 5- to 7-year operational cycle of Navy ships with concurrent economic benefits in lower propulsion costs. In addition, operational advantages of TBT paints included increased endurance, higher ship speeds, and less time devoted to hull maintenance.

The shipboard evaluation of TBT paints began in earnest in the 1980-1985 period with 13 Navy hulls fully painted with TBT paints. All but one hull had commercial EPA registered paints with TBT and copper as the biocides. The lead ship was the destroyer SPRUANCE, which demonstrated a 6-year capability of TBT paint. A Coast Guard ship achieved a 7-year cycle for a TBT paint.

In 1987, the BADGER was painted with TBT paint as part of the two-harbor Navy study mandated by Congress.

II. NAVY RESEARCH AND DEVELOPMENT (R&D)

The Navy has been active in TBT research and development (R&D) for over 15 years spanning evaluation of paint performance, management of waste and dock discharge, methods to determine TBT concentrations, environmental studies, acute and chronic toxicity effects on marine organisms, harbor monitoring, environmental assessments, and computer modeling harbor waters. At the present time, the main R&D efforts in TBT are primarily in the environmental area and are centered on the Navy Organotin Two-Harbor Case Study in Pearl Harbor Naval Shipyard and Mayport, Florida. The objectives of the study are:

- Determine whether the Navy can predict ambient TBT concentrations resulting from the use of TBT paints.
- Collect pertinent exposure data to determine whether Navy ships with TBT paint pose unacceptable risks to the marine environment.
- Quantify and model TBT discharge from Navy dry docks.

- Provide EPA and the States the results of the program.

Based on the Navy's R&D programs over the years, it appears that:

- TBT is not persistent in the marine environment. It is degraded rapidly by microbial action in water with a decay rate of about 10 percent per day.
- Fish, crabs, and shrimp appear to rapidly metabolize and, consequently, do not accumulate TBT; they are not very sensitive to TBT exposure.
- Mollusks do accumulate TBT, but apparently not when TBT concentrations are low (e.g., less than 100 parts of TBT per trillion (pptr)).
- It appears that water concentrations of 50 pptr should not result in adverse effects on aquatic life.
- Navy use of TBT should not cause concentrations greater than 50 pptr in any Navy harbor.
- Navy can predict TBT concentrations reasonably well by computer modeling.
- The painting of the BADGER at Pearl Harbor demonstrated low dock discharge which dissipated in 24 hours with virtually no effect on background levels of TBT in harbor waters.

The following are the participants in the current Navy R&D program on organotin:

Navy organizations

- David Taylor Naval Ship Research and Development Center
- Naval Ocean Systems Center
- Office of Naval Research

National Bureau of Standards

U.S. Army Corps of Engineers Waterways Experiment Station

Virginia Institute of Marine Sciences

Johns Hopkins University Applied Physics Laboratory

Harbor Branch Foundation

University of Georgia Skidaway Institute of Oceanography

GEO-Centers, Inc.

GKY & Associates, Inc.

SRA Technologies, Inc.

Camp, Dresser & McKee, Ins.

Computer Sciences Corporation

In 1983, the Navy identified ablative copper paints as a backup to TBT paints, should the latter be restricted by environmental concerns. Since 1983, 21 Navy hulls have been painted with ablative copper paint. The longest period of paint performance to date is over 3-1/2 years, on the lead Navy frigate AINSWORTH. These paints are not expected to match the longevity and reliability of TBT paints for periods above 5 years. No alternative to TBT paint in terms of long-term performance potential has been identified. For aluminum hulls, there is no alternative to TBT paints, even for short periods.

III. COSTS RELATED TO PAINTING

The direct cost avoidance benefit of TBT paint for the Navy is some 100 million dollars per year when full implementation is achieved. Penalties, if TBT paints are not used, are:

- Reduction of maximum attainable speed by as much as 10 knots.
- Increase in underway fuel consumption up to 16 percent.
- Increase in underway refueling frequency.
- Decrease in maximum cruising ranges.
- Increase in self-generated noise in degradation of ability to avoid detection and to detect targets.
- Increase of maintenance as a result of higher duty of the propulsion system, and more frequent dockings and hull cleaning.

The cost of using paints with lower TBT release rates is no different than that for high TBT release rate paints. The Navy was and is the lead advocate of use of low release rate paints.

IV. NAVY RECOMMENDATIONS

The Navy has three essential recommendations to make to improve the Tributyltin Based Antifouling Paint Control Act:

- The maximum acceptable release rate for steel hulls should be 5.0 micrograms TBT/cm^2/day by the EPA method instead of 0.5.
- Because aluminum-hulled craft must use TBT antifouling paints, they should therefore be allowed to use them without restrictions.
- The act should include language which relieves the Navy of the current ban on its use of TBT paints.

Explanations for these recommendations follow:

The data call-in, as a result of the EPA special review on TBT paints, requires the release rates of TBT from paints under laboratory conditions using a draft method of the American Society for Testing and Materials (ASTM). This draft ASTM method is the current EPA method.

The Navy developed its own release methods several years earlier. One method is for laboratory use; the other measures the rate directly on the hull of a ship. Release rates of tributyltin paints measured by the Navy and EPA methods give substantially different results. Two paints for steel-hulled ships have TBT release rates of 0.1 and 0.2 by the Navy method and 1.9 and 4 micrograms/cm^2/day by the EPA method. A copper-free TBT paint approved by the Navy for aluminum craft has a release rate of 1.5 by the Navy method and 1.8 micrograms/cm^2/day by the EPA method. All of these low release rate paints with proven antifouling performance on Navy ships would be rejected by the release rate limit currently shown in S. 428. Accordingly, the Navy recommends that the release rate limit currently shown in S. 428 be changed from 0.5 to 5.0 micrograms TBT/cm^2/day as long as the EPA method is used (10.0 micrograms TBT/cm^2/day for aluminum hulls). If this change is not adopted, most or possibly all high performance TBT paints would be eliminated by the release rate limit currently shown in S. 428, which is not the intention of the bill's sponsors.

The Navy owns a number of aluminum hull ships and boats; their total wet hull area amounts to 244,000 square feet which is about 2 percent of the total Navy hull area. These consist of hydrofoils and various patrol boats.

Aluminum craft must use TBT paint free of copper. There are no alternatives. Copper is present in most TBT paints used on steel hulls. The Navy has been using copper-free TBT paints on aluminum hulls for over 20 years. The environmental impact from Navy aluminum ships is small when compared to the total fleet.

State bills to control TBT paints that were passed by Virginia and Maryland legislatures allow 5.0 micrograms TBT/cm^2/day leach rate for paints used on steel hulls above 25 meters in length. These same bills exempt aluminum hulls from regulations. The U.S. Navy finds these state bills acceptable and in agreement with our recommendations given to you today.

The Navy has been prohibited by Congress from using these high performance state-of-the-art paints in 1986 and 1987 due to environmental concerns. The 1987 prohibition, however, excludes aluminum vessels. It is recommended that the final version of S. 428 include language which removes restrictions on the Navy's use in the FY 1987 DoD Appropriations Act, restrictions which currently apply only to the Navy. We request that it include the following provisions:

1. The maximum acceptable release rate for steel hulls should be 5.0 micrograms TBT/cm^2/day by the EPA method instead of 0.5.
2. Aluminum-hulled craft must use TBT antifouling paints and therefore should be allowed to use them without restrictions. Additionally, the Coast Guard advised that its aluminum-hulled vessels should be treated accordingly.
3. Include language which relieves the Navy of the current ban on its use of TBT paints.

This is a reasonable request because, even at full implementation, the U.S. Navy would use only 5 percent of TBT that goes into hull paints in the U.S., and would contribute less than 2 percent of TBT leached into U.S. coastal waters today.

The Navy wishes to express its concern that we do not have a national water quality standard or criterion for tributyltin concentration. The availability of this TBT concentration could be more important than some aspects of control of release rates of paint because a rational decision on an acceptable leach rate in a coastal body of water is critically dependent on acceptable water column concentrations of TBT. The absence of a national TBT water criterion makes it very difficult to negotiate TBT issues with State and local authorities.

SUBCOMMITTEE ON ENVIRONMENTAL PROTECTION

OF THE

COMMITTEE ON THE ENVIRONMENT AND PUBLIC WORKS

UNITED STATES SENATE

FORMAL RESPONSE TO THE

SENATE BILL S.428

TRIBUTYLTIN-BASED ANTIFOULING PAINT CONTROL ACT OF 1987

"PERFORMANCE AND ECONOMIC IMPACTS"

BY:

JOHN W. LUDGATE, JR.
INTERNATIONAL PAINT COMPANY

APRIL 29, 1987

Committee on the Environment
and Public Works

April 29, 1987

Senator George J. Mitchell
Chairman
Subcommittee on Environmental Protection
United States Senate
Washington, DC

Dear Mr. Chairman:

In response to your letter of April 15 requesting my testimony regarding the proposed legislation S.428, I have included the following written response.

My purpose here today is to present as much information as possible with specific emphasis on the role of antifouling paints in the marine industry, the technology of antifouling paints, the percentage of TBT used in antifouling paints, expected cost and economic impact due to proposed legislation, and the impact of proposed Bill S.428 the "Tributyltin-Based Antifouling Paint Control Act of 1987."

At the present time, International Paint firmly believes the studies which have been initiated because of the questions concerning the use of TBT in antifouling paints should be continued and all of the data gaps which exist regarding the question of TBT need to be definitively identified. International Paint fully supports the Data Call-In being conducted by the Environmental Protection Agency and we recommend any legislation be postponed until the results of this call-in are complete, so responsible regulations may be promulgated based on hard scientific fact; hard Scientific fact which takes into account the performance and fate of TBT in the real life environment and not just in the laboratory.

Thank you.

Very truly yours,

John W. Ludgate Jr.
John W. Ludgate, Jr.

Attachments

1) WHY ARE ANTIFOULING PAINTS USED?

Antifouling paints are used for one primary reason: to keep the hull of a vessel free from fouling. Fouling is a term used to describe the attachment to and growth of organisms on the hull of a vessel. Fouling increases roughness or "drag" on the vessel and this drag, reduces the ability of the vessel to move through the water. To overcome this drag, a vessel must burn additional fuel to gain more power to overcome the drag resulting from fouling. In addition, the growth of fouling can also result in damage to the anticorrosive coating of paint which protects the hull from rusting. Damage to this protective coat will allow water to pass through to the vessel's hull and the result will be rusting. The end result of this will be complete rust through of the hull and permanent damage.

It has been estimated that 50% of a commercial vessel's operating costs are fuel costs. One study showed a vessel with 5% of its hull area fouled will increase its fuel consumption by 5-10%. A vessel with 33% of its hull area fouled will increase its fuel consumption by up to 50%.

Also, the longer a ship can go between drydockings translates into a real cost savings. Estimates indicate an increase in the time between drydockings from 24 to 30 months would provide an annualized savings of $50,000/yr per ship in service.

A vessel using TBT copolymer paint realizes a real savings in fuel and maintenance costs and maintains a competitive position. Estimates of fuel savings alone can be between $200,000 to $400,000 per vessel per year.

TBT paints are associated not only with the performance of ships and boats per se, but also in mitigating the corrosion associated with the use of cuprous oxide paints on aluminum hulls. This is discussed in Section 7 in greater detail.

2) TYPES OF ANTIFOULING PAINTS

Antifoulings paints are active against fouling, such as grasses, slime, algae, barnacles, etc., due to the incorporation of biocides into the paint film. Copper and tin are the two most common biocides presently used. Copper has been used on ship hulls since the 1700's. Although effective, copper has always needed a booster biocide to act with it, since several plants and seaweeds are resistant to copper. The use of tin started in the late 60's.

International Paint was one of the first paint companies to use TBT and holds several patents with these products. International Paint has sales throughout the world of TBT copolymer antifoulings. Every major Navy uses TBT copolymer with the exception of the United States.

Basically, there are two ways in which TBT is incorporated into antifouling paint which are available on the market today, these are:

Free Associated Tin

TBT Copolymers

Limitations of Free Associated Paints

Free Associated paints have the TBT physically blended into the paint. There is no chemical bond between the TBT and the paint film, so that, the release of tin cannot be controlled since the distribution through-out the paint film is random. Usually, the tin will gravitate to the paint surface resulting in a high initial release of tin.

There are several drawbacks associated with this type of technology including the fact the paint film is only effective for 24 to 30 months, at most. The reason for this lies within the film of the paint. Biocides find channels through which leaching takes place and the surface layer of the film "washes" away exposing fresh biocide. Unfortunately, the paint film does not completely wash away and after the effective life of this type of coating, there still remains unspent biocide in the remaining film. Consequently, the remaining film needs to be removed to insure a clean substrate for the application of new antifouling paint which lead to the development of TBT copolymer paints.

This type of antifouling paint employs the use of cuprous oxide and TBT compounds such as tributyltin oxide and tributyltin fluoride.

Advantages of TBT Copolymers

The second type of antifouling paint, and the state of the art in antifouling technology is TBT copolymer paint. In the case of a TBT copolymer, the TBT is chemically bound to the matrix of the paint film. After the TBT copolymer paint is immersed in water, chemical bonds holding the TBT to the chemical paint matrix are broken at the surface of the film thus allowing very small amounts of TBT to be released. As this occurs, the remaining surface of the paint film is rendered water soluble and polishes away thus resulting in a renewal of the biocide release. It is important to note the level of TBT being released from this type of paint is markedly lower than a free associated type, as shown in Section 5.

The reason for the reduced release rate is due to the fact that the mechanism of TBT release is quite different with a copolymer than a free associated. The copolymer is essentially hydrophobic, and seawater does not penetrate the paint film. Only at the surface of the paint is seawater able to interact with the hydrophobic copolymer, initiating a reaction which cleaves tributyltin from the copolymer backbone and releases it into the water.

Conversely, free associated paint has water soluble components in the paint film which allow for the undercutting and eventual release of the film and biocide. This mechanism is based upon physical wearing or eroding of the paint film layer and is very sensitive to vessel speed, salinity, temperature, film thickness, etc.

Because of this mechanism, TBT copolymers represented a technical breakthrough in the field of antifouling technology. As a result, for the first time a paint manufacturer could predict how long a paint film would last by adjusting the thickness of the coating applied.

Another additional benefit derived from the use of TBT copolymers is, at drydocking, after the TBT copolymer has polished away, the remaining paint does not have to be blasted off unlike copper and free associated paints. All that is required is a high pressure water wash and fresh copolymer can be applied. **This eliminates the need for disposing of spent paint film.**

3) HISTORY OF USE

Free associated TBT paints have been used since the mid to late '60's with TBT copolymer paints being introduced in the mid 1970's. Sales of TBT copolymer paints have grown steadily over the years and according to International Paint estimates, 70% of the world's deep sea fleet uses this type of antifouling.

More importantly, 90% of all new ships have TBT copolymer applied to their hulls at construction. Japan with the largest Merchant Marine of over 10,000 vessels has almost 100% of all new ships coated with TBT copolymer.

TBT chemicals have been tested for many years in a number of acute and chronic animal studies in a continuous effort to learn as much as possible about the potential human health effects of these chemicals. **To date, there is no evidence that organotins are carcinogenic, mutagenic, teratogenic, or cause reproductive health effects**. As a class of chemicals, they have been subjected to extensive testing. **In every case, the government agency involved in the registration process found the organotin was suitable for its intended use.**

At the present time, the U.S.E.P.A. is conducting a special review regarding the use of TBT in antifouling paints and as part of this review has initiated a data call-in which requires additional information and data to be supplied by both TBT manufacturers as well as paint manufacturers employing TBT in their paint formulas.

4) MARKET DISTRIBUTION OF ANTIFOULINGS TYPES

In the United States, we estimate the annual total market for antifouling paints to be 1.4 million gallons. The breakdown of antifouling by type is as follows;

Copper only	42%
Free Associated Tin	18%
TBT Copolymer	40%

Since their introduction in the mid 1970's, we estimate over 4 million gallons of TBT Copolymer has been used in the United States.

These market figures include both the commercial/industrial and the recreational sectors. A detailed composition of these two respective markets is as follows;

	Commercial (800,000 gallons)	Recreational (600,000 gallons)
Copper only	25%	70%
Free Associated Tin	20%	10%
TBT Copolymer	55%	20%

These estimated figures show a dramatic difference between the products used in the two different markets. **The commercial sector is much more concerned with associated fuel savings from using copolymers and as a result, copolymers are the primary product used. Although the use of copolymers is increasing in the recreational market, it is only about 20% of the amount used in the commercial segment.**

5) RELEASE RATES OF ANTIFOULING PAINTS

Why Different Methods Yield Different Results?

A major concern of industry is defining the maximum allowable release rate of TBT.

The problem occurs as a result of two different test methods which have given different results for the same sample of paint. In the Navy test method, a standard sample of TBT copolymer measured a typical release rate of 0.1 - 0.5 ug/sq.cm./day.

The same sample of paint tested by the EPA, which was adopted from a proposed test from the American Society for Testing and Materials (ASTM), indicated a typical release rate of 3.0 - 5.0 ug/sq.cm/day.

The difference in these results was due to the test methods and not related to the level of TBT in the paint sample.

Paint Sample	Tin Release Rate (ug/sq.cm./day) using Navy Test	Tin Release Rate (ug/sq.cm./day) using EPA Test
Std. TBT Copolymer	0.15	4.22

At the time this bill was drafted in 1986, a maximum release rate of 0.5 ug/sq.cm./day was though to be acceptable since this was based upon the current Navy test method. Since that time, the EPA has now adopted a test and the maximum release rate, according to this method, is 5.0 ug/sq.cm./day.

We are recommending the maximum release rate in S.428 be changed to reflect this method.

6) PERFORMANCE OF TBT COPOLYMER ANTIFOULING PAINTS

TBT copolymer antifouling paints have been used extensively since the mid 1970's. International Paint's Data Plan(R) is a computerized tracking system used to track the performance of coatings applied to over 16,000 vessels worldwide.

When considering antifouling performance, it is difficult to make exact comparisons because many factors influence the performance of an antifouling on a particular vessel. Data Plan has kept accurate records of 16,000 vessels since 1978, so we can make accurate predictions about the probability of performance with a antifouling based upon actual experience.

99% of vessels using TBT Copolymer will have a clean hull after a 24 month period, Free Associated tin will have about 65% of vessels clean and Copper will have 45% clean. We define clean as a hull with less than 9% of its area fouled.

The history of performance for TBT copolymers has shown that after 5 years, over 90% of the vessels coated with TBT copolymers have remained foul-free. It is because of this excellent cost/performance and safety of these TBT copolymers that their acceptance has been wide-spread.

7) ECONOMIC IMPACT of S.428

Quantification of the impacts on any limitation on the use of TBT in antifouling paints is a complex issue. There are two scenarios to consider; A.) If regulations were enacted which completely banned the use of TBT, B.) If S.428 is enacted. The following economic sectors would be affected:

1) The Federal Government, including the U.S. Navy and the U.S. Coast Guard;

2) The U.S. Merchant Marine;

3) U.S. Shipyards;

4) Segments of the U.S. Economy dependent upon marine shipping for the receipt of goods;

5) U.S. Corporations transporting bulk commodities in ocean vessels; and

6) The large industry that manufacturers and services pleasure craft in the U.S.

Impact on the Federal Government:

Admiral Ricketts of the United States Navy will address the immediate impact the proposed limitation of TBT will have on the Navy. Appendix 1 contains an article from *Marine Engineering Log*, March 1987, which highlights the necessity of using TBT copolymers for Naval defense.

The Coast Guard is severely effected by any ban, since they have many aluminum hull vessels which cannot use copper containing materials. Copper in contact with the aluminum will cause galvanic corrosion due to dissimilar metals.

Impact on the U.S. Merchant Marine:

A.) The impact of a ban of TBT paints on the U.S. Merchant Marine would be substantial, and such a ban would hit an economic sector already in a depressed condition. The effect would be to increase the cost differential between U.S. Flag vessel and ships from foreign countries since there would ba no practical way of preventing TBT treated vessels flying flags of different nations from sailing into U.S. ports.

As stated earlier, vessels without TBT copolymer based antifouling paints incur a higher operating cost in both fuel as well as drydockings. Studies have documented the savings on fuel alone for oil tankers using TBT copolymers to be $200,000 to $400,000 per year.

B.) With the change in release rate to 5.0 ug/sq.cm./day, S.428 would have no major negative impact on the merchant marine since most TBT copolymers will meet that maximum release rate. As mentioned earlier, 70-75% of all commercial vessels use TBT copolymers, consequently, the effect would be positive in moving the market away from high release free associated paints.

Impact on U.S. Shipyards:

A.) The shipyard industry of the United States consists of yards specializing in new construction and yards specializing in maintenance and repair. Shipyards employ approximately 125,000 workers, of which the vast majority are involved primarily in maintenance and repair work.

The domestic industry has already lost most its new commercial construction business (except for Military and a very few subsidized vessels) to foreign competitors due to economic factors. The same economic factors have been steadily eroding the volume of domestic drydockings and, indeed, some vessels now make special voyages overseas simply to take advantage of lower drydocking costs.

Any inability in the United States to obtain TBT based antifoulings would, by itself, be sufficient to cause many shipowners to select foreign shipyards.

Restrictions on the use of TBT antifouling paints in the United States with respect to commercial vessels would make the United States the only country in the world where such paints were not available. It is difficult to avoid the conclusion, therefore, that significant restrictions would cause economic hardship to the ship repair industry, beyond what it is already experiencing.

B.) The effect of S.428, provided the release rate is changed to 5.0 ug/sq.cm./day, on the shipyards will be to eliminate the usage of free associated paints which have higher release rates, to the use of TBT copolymer paints which have lower release rates.

Impact on Recreational Boating:

A.) A complete ban on all TBT based paints would have very serious impacts on all parts of the recreational boating industry. Aluminum vessels would be virtually eliminated from operation causing undue hardship on existing users, as well as, builders specializing in such vessels. The reason for this is due to the fact that copper containing materials cannot be used on aluminum hulls or parts. This is because of galvanic corrosion which occurs when two dissimilar metals come into contact.

There is also concern about painting the outboard motors, outdrives and underwater metals with copper based paint since these items are constructed from aluminum or soft alloys and would seriously corrode if exposed to copper containing materials. Manufacturers will not warranty this equipment if copper paint is used and a question of liability arises.

B.) S.428 will alleviate most of the above problems in the recreational sector, but will have a significant impact since there are no products which are copper free and have a release rate of TBT below 5.0 ug/sq.cm./day. As stated above, this directly impacts both the aluminum hull boats and the outboard motors and outdrives on all craft.

8) ALTERNATIVES TO TBT

At the present time there are no satisfactory alternative biocides to the use of TBT in antifoulings.

9) RECOMMENDATIONS

A.) International Paint believes any legislation should be postponed until all the facts are collected and analyzed by the EPA as part of the Data Call-in.

B.) International Paint fully supports the EPA in this effort and we will continue to cooperate with all technical information.

C.) We recommend that S.428 be predicated upon the EPA release rate test and the maximum release rate be changed accordingly to from 0.5 to 5.0 ug/sq.cm./day.

D.) We also recommend there be an exception for aluminum hulls and outboard units. This is due to the incompatibility of the metals with a copper only paint. The Coast Guard is especially effected by this exception.

10) CONCLUSIONS

In conclusion, the marine paint industry has improved its antifouling paint products by moving from cuprous oxide to tributyltin based biocides. Further, it has improved its TBT based products by introducing TBT copolymer paints. These paints represent advances in the state of technology over free associated since they decrease fuel consumption and maintenance costs associated witn vessel operation.

Actions taken to restrict the use of TBT copolymer paints could have deleterious impacts on numerous sectors of the U.S. economy, including the Federal Government, the U.S. merchant marine, U.S. shipyards, specific geographic sectors of the U.S. economy, specific industries in the U.S. economy and the recreational industry. The extent of those impacts will vary substantially depending upon sector and other related variables.

The Environmental Protection Agency, with the initiation of its data call-in, has set in motion the steps necessary to gain the data needed to pass regulations directed towards the elimination of high release rate TBT paints. By allowing this data to be generated prior to the promulgation of regulations, all segments of society involved in this question should be satisfied, with no undue, unnecessary hardship placed on any one.

Thank You.

STATEMENT OF
JAMES M. SEIF
REGIONAL ADMINISTRATOR
U.S. ENVIRONMENTAL PROTECTION AGENCY
BEFORE THE
SUBCOMMITTEE ON ENVIRONMENTAL PROTECTION
COMMITTEE OF ENVIRONMENT AND PUBLIC WORKS
UNITED STATES SENATE
APRIL 29, 1987

I AM JAMES M. SEIF, REGIONAL ADMININSTRATOR OF THE MIDDLE ATLANTIC REGION OF THE ENVIRONMENTAL PROTECTION AGENCY IN PHILADELPHIA. OUR REGION INCLUDES MOST OF THE CHESAPEAKE BAY DRAINAGE BASIN. I AM PLEASED TO JOIN YOUR DISCUSSIONS TODAY ON TRIBUTYLTIN (TBT). AS REGIONAL ADMINISTRATOR, I AM A MEMBER OF THE CHESAPEAKE EXECUTIVE COUNCIL, THE BODY CREATED ON DECEMBER 9th, 1983 BY THE GOVERNORS OF MARYLAND, VIRGINIA, AND PENNSYLVANIA, THE MAYOR OF THE DISTRICT OF COLUMBIA, THE CHAIRMAN OF THE CHESAPEAKE BAY COMMISSION AND THE ADMINISTRATOR OF THE ENVIRONMENTAL PROTECTION AGENCY. ITS ROLE IS TO OVERSEE AND COORDINATE PLANS TO RESTORE AND PROTECT THE WATER AND LIVING RESOURCES OF THE CHESAPEAKE BAY ESTUARINE SYSTEM.

THANK YOU, SENATOR MITCHELL, FOR THE OPPORTUNITY TO TESTIFY ON THIS TOPIC OF IMPORTANCE TO THE ECOSYSTEM OF THE CHESAPEAKE BAY.

LET ME START WITH A BRIEF BACKGROUND, THEN DESCRIBE REGION III's "SAMPLING SURVEY OF TRIBUTYLTIN CONCENTRATIONS AT SELECTED HARBORS IN CHESAPEAKE BAY" -- WHICH I WILL SUBMIT FOR THE RECORD, AND PRESENT ITS RESULTS AND CONCLUSIONS.

BACKGROUND

THE MATTER OF TBT USE IN THE BAY ATTAINED HEIGHTENED PROMINENCE LAST YEAR WHILE I WAS CHAIRMAN OF THE CHESAPEAKE EXECUTIVE COUNCIL. DURING OUR DISCUSSIONS, WE BECAME CONCERNED ABOUT THE POSSIBLE ENVIRONMENTAL IMPACT OF THE WIDESPREAD USE OF TBT-BASED ANTIFOULING PAINTS ON THE HULLS OF BOATS SAILED AND BERTHED IN BAY WATERS. WHILE OUR IMMEDIATE FOCUS OF ATTENTION WAS ON THE PLANNED FLEETWIDE USE OF TBT-BASED ANTIFOULING PAINTS BY THE U.S. NAVY, COUNCIL MEMBERS SOON REALIZED THAT, BECAUSE OF THEIR NUMBERS, RECREATIONAL BOATS POSE A POSSIBLY GREATER THREAT TO THE DELICATE BAY ECOSYSTEM. MARYLAND ALONE HAD 150,858 REGISTERED PLEASURE CRAFT IN 1986.

TRIBUTYLTIN, THE ACTIVE INGREDIENT IN MANY ANTIFOULING PAINTS, HAS BEEN SHOWN IN LABORATORY EXPERIMENTS TO BE TOXIC TO NON-TARGET AQUATIC ANIMALS AT EXTREMELY LOW CONCENTRATIONS. TESTS SHOW HARM CAN BE CAUSED TO SHELLFISH LARVAE FROM AS LITTLE AS 100 PARTS PER TRILLION. THE COUNCIL THEREFORE QUESTIONED WHETHER THERE MIGHT BE LONG TERM ADVERSE EFFECTS ON MARINE LIFE AND THE GENERAL ENVIRONMENTAL HEALTH OF THE BAY.

DURING THE COUNCIL'S JANUARY 16, 1986 MEETING, WE AGREED TO SEND A LETTER AND RESOLUTION TO BOTH THE SECRETARY OF THE NAVY AND THE ADMINISTRATOR OF THE EPA. THE COUNCIL RECOMMENDED THAT EITHER THE NAVY PREPARE AN ENVIRONMENTAL IMPACT STATEMENT (EIS) OR THAT EPA INITIATE A STUDY OF COMPARABLE SCOPE TO DESCRIBE THE POTENTIAL ENVIRONMENTAL CONSEQUENCES OF THE USE OF TRIBUTLYTIN-BASED ANTIFOULING PAINTS, INCLUDING THEIR USE BY THE NAVY AS WELL AS BY COMMERCIAL AND RECREATIONAL USERS.

THE SURVEY

EPA'S DR. JOHN MOORE, ASSISTANT ADMINISTRATOR FOR PESTICIDES AND TOXIC SUBSTANCES, IS HERE TODAY TO DESCRIBE THE SPECIAL REVIEW OF TBT USE IN ANTIFOULING PAINTS WHICH BEGAN IN JANUARY 1986. IN FEBRUARY 1986, REALIZING THAT DATA ON TBT IN THE MARINE ENVIRONMENT WERE LIMITED, EPA's OFFICE OF PESTICIDE PROGRAMS IN WASHINGTON ASKED REGION III's CHESAPEAKE BAY LIAISON OFFICE IN ANNAPOLIS, MARYLAND (CBLO) TO DEVELOP AND CARRY OUT A SMALL SCALE SAMPLING PROGRAM. A SURVEY PROGRAM WAS DESIGNED TO MEASURE CONCENTRATIONS OF TRIBUTYLTIN AND ITS PRINCIPLE DEGRADATION PRODUCT, DIBUTYLTIN (DBT), IN THE ESTUARINE ENVIRONMENT. A TECHNICAL WORK GROUP, INCLUDING VIRGINIA AND MARYLAND GOVERNMENT AND UNIVERSITY SCIENTISTS AS WELL AS EPA PESTICIDES EXPERTS, PARTICIPATED IN CRITIQUING THE STUDY PLAN.

THEY AGREED THAT THE SURVEY HAD TO BE CONDUCTED DURING THE 1986 BOATING SEASON TO MAXIMIZE ITS USEFULNESS. SITES HAD TO COVER A RANGE OF BOATING AND SHORELINE MARINA ACTIVITIES, FROM INTENSE TO MINIMAL, AND BE IN AN AREA WHICH COULD BE SAMPLED WITHIN THE SHORT TIME AND WITH THE SAMPLING VESSELS AVAILABLE. FOR THESE REASONS ALL AGREED TO FOCUS THE STUDY ON FOUR MARYLAND HARBORS NEAR THE CBLO. THEY FURTHER AGREED THAT THE HARBORS CHOSEN WERE REPRESENTATIVE OF THOSE WHICH MIGHT HAVE BEEN SAMPLED IN VIRGINIA WATERS.

SOLOMONS, ANNAPOLIS, OXFORD AND PLAINDEALING CREEK WERE SELECTED AS THE STUDY SITES. ANNAPOLIS AND SOLOMONS BOTH EXPERIENCE HIGH LEVELS OF BOATING AND SHORELINE MARINA ACTIVITIES, HAVING 790 AND 1300 BOATSLIPS, RESPECTIVELY. OXFORD HAS A MEDIUM ACTIVITY LEVEL WITH 640 SLIPS, AND PLAINDEALING CREEK HAS UNDER 10 PRIVATE SLIPS AND NO MARINAS.

DURING THE SUMMER BOATING SEASON, MAY 5 TO SEPTEMBER 15, 1986, THE CBLO COLLECTED WEEKLY WATER SAMPLES AT FOUR MONITORING STATIONS AT EACH OF THE FOUR SITES. IN ADDITION, FOUR STATIONS WERE SAMPLED HOURLY OVER A FULL TIDAL CYCLE TO DETERMINE THE EFFECT OF TIDAL STAGE ON TBT CONCENTRATIONS. SAMPLES WERE FROZEN AND SHIPPED OVERNIGHT TO USEPA's ENVIRONMENTAL RESEARCH LABORATORY IN GULF BREEZE, FLORIDA FOR ANALYSIS. WE USED THAT LABORATORY BECAUSE IT WAS THE ONLY EPA LABORATORY WITH THE EQUIPMENT AND THE EXPERIENCE TO RUN THE NECESSARY ANALYSES.

THE FOUR MONITORING STATIONS AT EACH SITE WERE SITUATED TO MEASURE THE CHANGE IN TBT CONCENTRATIONS FROM POINTS WHICH ARE WITHIN THE CONFINES OF THE HARBOR TO POINTS LOCATED OUT INTO THE ADJACENT RIVER SYSTEM. THE STATIONS WERE EQUALLY SPACED ALONG A LINE FOLLOWING THE PREDOMINANT CURRENT PATTERN OF THE HARBOR WATERS AS THEY FLOW INTO THE RIVER. THEY WERE LOCATED TO HELP DETERMINE THE EXTENT OF TBT EXPOSURE FROM THE AREAS OF MAXIMUM BOATING ACTIVITY. TWO STATIONS AT EACH SITE WERE ADJACENT TO THE MOST INTENSE BOATING ACTIVITY. A THIRD WAS LOCATED WHERE THE HARBOR AND THE RIVER WATERS MIX, AND THE FOURTH WAS IN THE RIVER OUTSIDE EACH HARBOR.

THE TECHNICAL REVIEW GROUP CONTINUED TO MEET TO DISCUSS TBT RESEARCH AND MONITORING AND TO EXCHANGE TECHNICAL INFORMATION. THE MEMBERS, WHICH NOW INCLUDE THE U.S. NAVY, HAVE PROVIDED TECHNICAL INFORMATION TO ASSIST IN DEVELOPMENT OF THE MARYLAND AND VIRGINIA TBT LEGISLATION. WE ARE GRATEFUL FOR THEIR ASSISTANCE.

THE RESULTS

THE RESULTS WHICH I WILL DISCUSS ARE PRELIMINARY IN NATURE AND REQUIRE FURTHER ANALYSIS AND QUALITY ASSURANCE VERIFICATION. HOWEVER, EVEN AT THIS STAGE, I BELIEVE THE DATA ARE INSTRUCTIVE AND PROVIDE USEFUL INFORMATION. OUR MONITORING EFFORT REVEALED THAT THE HIGHEST CONCENTRATIONS OF TBT, UP TO 530 PARTS PER TRILLION, WERE MEASURED IN MID-MAY AT THE ANNAPOLIS SITE WITHIN THE HARBOR. THESE PEAKS IN CONCENTRATIONS OCCURRED AT THE TIME WHEN MOST BOAT OWNERS LAUNCH THEIR NEWLY PAINTED RECREATIONAL BOATS. MAY TO JUNE IS THE CRITICAL SPAWNING PERIOD FOR STRIPED BASS AND OYSTERS IN CHESAPEAKE BAY. FROM MID-JUNE THROUGH MID-SEPTEMBER TBT CONCENTRATIONS REMAINED WITHIN A CONSTANT RANGE AT EACH OF THE FOUR ANNAPOLIS STATIONS. THERE WAS NO DOWNWARD TREND IN CONCENTRATIONS OVER THE BOATING SEASON. DURING THE LENGTH OF STUDY (20-WEEKS) THE AVERAGE CONCENTRATION LEVEL AT THE MONITORING STATION IN ANNAPOLIS HARBOR WAS 110 PARTS PER TRILLION. THE AVERAGE CONCENTRATION LEVEL AT THE MONITORING STATION IN THE HARBOR ENTRANCE, 200 YARDS DOWNSTREAM, WAS 47 PARTS PER TRILLION; AND, AT THE STATION IN THE SEVERN

RIVER, LESS THAN HALF A MILE AWAY FROM THE FIRST STATION, IT WAS 33 PARTS PER TRILLION.

AT THE SOLOMONS SITE, SIMILARLY LOCATED STATIONS SHOWED THE SAME PATTERN. IN THE HARBOR ADJACENT TO HIGH BOATING ACTIVITY WE MEASURED TBT CONCENTRATIONS OF UP TO 120 PARTS PER TRILLION. AT THE HARBOR MOUTH AND IN THE PATUXENT RIVER THE AVERAGE CONCENTRATION OVER THE 20 WEEKS WAS 20 PARTS PER TRILLION.

THE OXFORD STATIONS WITHIN THE HARBOR HAD TBT CONCENTRATIONS WITH A RANGE FROM NONDETECTABLE TO 61 PARTS PER TRILLION. STATIONS ADJACENT TO THE HARBOR AND IN THE TRED AVON RIVER RANGED UP TO 50 PARTS PER TRILLION. THE COMBINED 20-WEEK AVERAGE FOR THE SITE WAS 28 PARTS PER TRILLON.

TBT WAS NOT DETECTED IN MOST OF THE SAMPLES FROM THE PLAINDEALING CREEK SITE. HOWEVER, CONCENTRATIONS AS HIGH AS 91 PARTS PER TRILLION WERE MEASURED AT SEVERAL OF THE PLAINDEALING CREEK STATIONS AT THE BEGINNING AND NEAR THE END OF THE SURVEY. CORRESPONDING DBT PEAKS WERE MEASURED AT SOME OF THE SAME PLAINDEALING CREEK MONITORING STATIONS ON THE SAME SAMPLING DATES. EPA's GULF BREEZE LABORATORY REVIEW OF THE LABORATORY QUALITY ASSURANCE/QUALITY CONTROL DATA INDICATES THAT THE REPORTED TBT AND DBT CONCENTRATIONS MAY BE UNDERESTIMATED BY AS MUCH AS 50 PERCENT. THE ANALYTICAL LABORATORY COULD ONLY MEASURE ACCURATELY UP TO 66 PERCENT OF THE TBT IN SAMPLES DUE TO THE LEVEL OF SENSITIVITY OF THE LABORATORY EQUIPMENT. FURTHER, SOME DEGRADATION OF TBT OCCURRED WHILE THE SAMPLES WERE IN FROZEN STORAGE. CONSEQUENTLY, BECAUSE OF THE LABORATORY EQUIPMENT SENSITIVITY LIMITATION AND BECAUSE OF THE TBT TO DBT DEGRADATION, WE MAY HAVE UNDERESTIMATED THE LEVELS OF THE MORE-TOXIC TBT.

CONCLUSIONS

BASED ON THIS INFORMATION, THE FOLLOWING CONCLUSIONS WERE REACHED. EACH OF THESE CONCLUSIONS IS MORE FULLY DISCUSSED IN THE COMPLETE DRAFT REPORT:

- SOURCES AND CONCENTRATIONS OF TBT MEASURED IN THE HARBOR AREAS APPEAR TO BE LINKED TO LOCAL LEVELS OF BOATING AND MARINA ACTIVITY, AND SPECIFICALLY TO TBT LEACHATE FROM ANTIFOULING PAINTS.

  THE HIGHEST TBT CONCENTRATIONS WERE MEASURED AT ANNAPOLIS, FOLLOWED BY SOLOMONS, OXFORD AND PLAINDEALING. IN ADDITION, THERE WERE NO SIGNIFICANT POINT SOURCE DISCHARGES TO THE AREAS SAMPLED, OR THEY WERE SAMPLED AND FOUND TO CONTAIN NO DETECTABLE TBT.

- HARBORS ARE A SOURCE OF TBT TO THE ESTUARINE ENVIRONMENT BEYOND THE BOUNDARIES OF THE HARBORS.

  THE HIGHEST CONCENTRATIONS OF TBT WERE MEASURED IN THE HARBORS NEAR AREAS OF HIGH BOATING AND MARINA ACTIVITIES. TBT CONCENTRATIONS WERE MEASURED AT HARBOR ENTRANCES AND IN THE RIVERS, ALTHOUGH CONCENTRATIONS SEEMED DILUTED BY PHYSICAL MIXING PROCESSES.

- TBT CONCENTRATIONS IN HARBORS IN THE CHESAPEAKE BAY AREA EXCEED THE PROPOSED ADVISORY CRITERIA OF 30 PPT FOR CONTINUOUS EXPOSURE; THEREFORE, IT APPEARS THAT THE CONCENTRATIONS ARE HIGH AND CONSTANT ENOUGH TO POSE A THREAT TO ORGANISMS LIVING IN THE HARBOR AREAS.

- FURTHER, SUSTAINED CONCENTRATIONS OF TBT AT THE LEVELS FOUND IN THE RIVERS ADJACENT TO THE SAMPLED HARBORS COULD CAUSE AN ADDITIONAL, UNNECESSARY ENVIRONMENTAL STRESS TO SHELLFISH LARVAE AND PLANKTON WHICH PROVIDE THEIR FOOD.

  THE EXTENT OF TBT CONTAMINATION AND IMPACT BEYOND THE MONITORED HARBOR IS STILL LARGELY UNKNOWN. HOWEVER, WHILE THESE HARBOR AREAS MAY ACT AS A SOURCE OF TBT TO ADJACENT RIVERS, THERE HAS BEEN VERY LIMITED MONITORING OF THESE RIVER SYSTEMS OR CRITICAL LIVING RESOURCE HABITATS FOR EVIDENCE. RESULTS FROM ONGOING LABORATORY TOXICITY TESTS CONTINUE TO SHOW ACUTE AND CHRONIC EFFECTS AT LEVELS MEASURED IN THE BAY.

THE CHESAPEAKE BAY LIAISON OFFICE HAS WORKED CLOSELY WITH THE OFFICE OF PESTICIDE PROGRAMS OVER THE PAST YEAR TO ENSURE RESULTS FROM MONITORING AND RESEARCH ACTIVITIES UNDERTAKEN ON CHESAPEAKE BAY ARE [illegible] IN THE SPECIAL REVIEW OF TBT USE IN ANTIFOULING PAINTS.

MR. CHAIRMAN, I WOULD BE PLEASED AT THIS TIME TO ANSWER ANY QUESTIONS OF INTEREST TO THE SUBCOMMITTEE.

Statement of Torrey C. Brown, M.D.
Secretary, Maryland Department of Natural Resources

Hearings On
Effects of Tributyltin Based Antifouling Paint On The Marine Environment

Subcommittee On Environmental Protection
Senate Committee on Environment and Public Works

April 29, 1987

Mr. Chairman and members of the Subcommittee on Environmental Protection, I am Torrey C. Brown, Secretary of the Maryland Department of Natural Resources. I am pleased to appear before you today to offer the views of the State of Maryland on the effects of tributyltin based antifouling paint on the marine environment and on legislative proposals which attempt to address this problem.

The State of Maryland has been blessed with a great variety of natural resources and certainly chief among them is the magnificent Chesapeake Bay. Our responsibility at the Department of Natural Resources is to ensure the preservation, wise use, and enjoyment of these bountiful resources for the greatest benefit to the State and its citizens. It is in this context that we have addressed the issue of the potential adverse effects of the widespread use of tributyltin based antifouling paint throughout the Chesapeake Bay area.

The Chesapeake Bay is one of the most biologically productive estuaries in the world. Annually, millions of pounds of seafood worth hundreds of millions of dollars are harvested in Maryland waters. In addition to the abundance of flora and fauna that are dependent upon the Chesapeake Bay, thousands of people use the Bay for swimming, boating, birdwatching and other esthetic and recreational activities. The impacts man has had on the Bay and its surrounding environment has been the subject of a great deal of studies and prolonged debates. In 1983, the U.S. Environmental Protection Agency completed a multiyear, multimillion dollar study of the Chesapeake. The results of that study showed a system in stress. When summarized, the findings indicate three major problem categories:

- Excessive nutrient enrichment;
- The threat of toxic substances; and,
- A serious decline in several living resources.

Specific recommendations were developed which intended to reverse the decline of water quality and to rehabilitate the Bay's living resources (EPA, 1983). In response to these findings, the States of Pennsylvania, Virginia, Maryland, the District of Columbia and the U.S. EPA joined together in a massive effort to restore the Chesapeake Bay. To date, these efforts are going well and significant progress has been made; but all agree that it will require a sustained commitment and a watchful eye to attain the desired results.

Of particular concern to everyone was the threat of toxic substances adversely affecting the Chesapeake Bay. The studies showed that metals and organic compounds which routinely were discharged into the Bay were detrimental to aquatic organisms (EPA, 1983). While it was agreed that strengthening and enforcing the laws and programs controlling the discharge of such toxic chemicals into the Bay was desirable, the best management strategy was to prevent them from being discharged at all.

Reports in the scientific literature have identified tributyltin as a substance which is extremely toxic to the aquatic system. The most notable example of this was the impact to the commercial oyster (*Crassostrea gigas*) in Archachon Bay in France. Tributyltin was suspected as being responsible for deformities and poor meat quality. After restricting the use of tributyltin, these problems were no longer observed and there was a return to an active oyster industry (Alziew, 1986). Knowing this, it was necessary to take measures to minimize any adverse impact to the Chesapeake Bay.

Tributyltin, a member of a general group of carbon based synthetic toxic chemicals known as organotins, is used as the active antifouling agent in many marine paints. Referred to as TBT, it is a very effective toxic agent and prevents or retards the attachment and growth of organisms to boat hulls. Studies have shown TBT to be toxic to marine and freshwater organisms at an extremely low concentration (Hall et al, 1984), measured at the parts per billion (ppb) and parts per trillion (pptr) level. Compared to copper (also used in marine paints to inhibit growth of fouling organisms) TBT, even at the ppb level, is more toxic, and has a much longer active life.

TBT, unfortunately, is also toxic to non-fouling resources. Included among these "non-target" resources affected by TBT are commercially and ecologically important fish and shellfish resources. Short-term exposure to high concentrations and long-term exposure to low concentrations of TBT elicit behavioral or biological responses by non-target biota that affects the organisms ability to survive. Reports have shown that short-term exposure to concentrations of TBT in excess of 100 pptr have caused various toxicity effects to aquatic resources. Effects observed range from avoidance reactions by fish to mortality of other test organisms (Cardwell et. al., 1986; Henderson et al. 1986; and Stephenson et. al., 1986). Young developmental stages of both large invertebrates and fish have been found to be much more sensitive to the effects of TBT than older life stages. Mollusks (eg. clams and oysters) have been found to be especially sensitive.

For the past several years the State of Maryland has been concerned about the possible adverse impacts of TBT on aquatic resources. When the scientific literature began reporting the toxic effects of TBT on marine organisms, we established a Maryland interagency task force to review the information and recommended needed action. In July of 1985 we initiated a field investigation to determine if TBT was present in Maryland waters and in what concentrations. Water samples were taken once a month for twelve (12) months at eight (8) sites around the Maryland portion of the Chesapeake Bay. These sites represented two small and two large commercial marinas, a large harbor, a major shipping channel and two major river systems (Table #1). The results of this study indicated that TBT is present and at some sample sites TBT exists in fairly high levels. Mean concentrations of TBT in all four marinas for the 12 month period ranged from 51-408 pptr. Peak concentrations of TBT were reported in May and June at 998 and 936 pptr respectively (Table #2).

TABLE #1

Tributyltin Sampling Locations

Hartge Marina	(Galesville, MD)
Port Annapolis Marina	(Annapolis, MD)
Pier 1 Marina	(Stevensville, MD)
Piney Narrows Marina	(Chester, MD)
Baltimore Harbor	(Baltimore, MD)
Chesapeake and Delaware Canal	(Chesapeake City, DE)
Choptank River	(Cambridge, MD)
Potomac River	(near Gov. Harry Nice Memorial Bridge, MD)

Table #2. Tributyltin (TBT) concentrations reported in the water column from eight sampling stations in Chesapeake Bay. (ND = not detected)- Values in parts per trillion.

						Month						
			1985						1986			
STATION	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June
Port Annapolis	293	268	464	261	223	39	68	54	105	187	998	936
Hartge	41	27	42	56	40	ND	ND	24	27	40	186	26
Pier 1	44	37	239	ND	68	46	37	ND	42	75	253	307
Piney Narrows	34	117	250	46	71	27	ND	75	49	29	153	338
Baltimore	ND	33	32	61	54	ND	ND	ND	46	44	60	112
C&D Canal	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Potomac River	ND	ND	20	24	ND	ND	ND	ND	ND	ND	ND	ND
Choptank River	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Source: Hall, et. al., 1986.

When the amount of TBT found during our field studies was compared to the levels which are reported in the scientific literature to be lethal to test organisms (Table #3), we concluded that TBT has the potential to harm non-targeted aquatic resources. Maryland therefore determined that the use of marine boat paints containing tributyltin is inconsistent with our ongoing Bay restoration programs and should be restricted.

Since Maryland was not alone in evaluating TBT in the Chesapeake Bay the Chesapeake Bay Regional Tributyltin Task Force was assembled in 1986 to review and coordinate the various efforts regarding tributyltin. The task force is chaired by the EPA Chesapeake Bay Liaison Office and consists of representatives from management and regulatory agencies in Maryland and Virginia, the EPA Office of Pesticide Programs, scientists from regional academic institutions and regional environmental interest groups. The creation of the Task Force was a recognition that TBT was a major environmental concern for all of the Chesapeake Bay and that regional solutions were necessary.

Working in conjunction with the Task Force and the marine trades industry, legislation restricting the use of marine boat paints containing TBT was drafted and enacted by the 1987 General Assembly. Maryland's legislation was sponsored by the Chesapeake Bay Commission, composed of Maryland, Pennsylvania and Virginia legislators, which proposed identical legislation in Virginia. Maryland and Virginia were able to act quickly to restrict the use of TBT in the Chesapeake Bay because of existing lines of communication on environmental issues, the knowledge base

TABLE #3

A SUMMARY OF AQUATIC BIOTA TOXICITY

	EFFECTS (LC 50) (ng/l)	
	Acute	Chronic
Algae	330 to 1030	-
Molluscs	100 to 2300	600 to 240
Crustaceans	300 to 41,000	1,000
Fish	960 to 24,000	200 to 10,00

Note: ng/l - parts per tillion

Source: EPA, 1985

developed from several years of activities and the sensitivity to the potential environmental impacts from toxic chemicals.

Maryland's legislation was unanimously supported by local and national environmental groups, state environmental and regulatory agencies and the marine trades industry. The bill prohibits the distribution, possession, sale, offering for sale, use or offering for use any antifouling paints containing tributyltin except for specific situations. These exemptions are that an owner or agent of a commercial boatyard may purchase and use TBT antifouling paint with the acceptable release rate of 5.0 micrograms per square centimeter per day if that paint is applied:

a) only within a commercial boatyard, and

b) only to vessels exceeding 25 meters in length or that have aluminum hulls

The Maryland legislation also requires the establishment of an educational program to advise boaters, boatyards, marine suppliers and other users of the new restrictions. In addition, there is a requirement for the publication of a list of antifouling paints which contain TBT with and without the acceptable release rate as well as available substitute paints.

Tributyltin is not just a Chesapeake Bay problem. TBT is used in increasing amounts in all of the coastal and inland water around the country. Researchers around the country have found levels of tributyltin similar to those found in the Chesapeake (Grovhoug, et.al, 1986; Stang et.al., 1986 and Weber, et.al., 1986). The potential to affect non-target aquatic resources in other bodies of water is as great as in the Chesapeake Bay.

(Grovhoug, et.al, 1986; Stang et.al., 1986 and Weber, et.al., 1986). The potential to affect non-target aquatic resources in other bodies of water is as great as in the Chesapeake Bay. In order to provide adequate protection to all of the Nation's waterways, there is a need for federal legislation to address this problem.

There are several issues we believe the Subcommittee should address when considering any Federal legislation in this area:

-- When freshly painted vessels are initially put into water, tributyltin at the surface of the paint easily and rapidly leaches or diffuses into the surrounding environment. Over time the ability of TBT molecules to leach from the paint slows to a constant rate. This usually takes about 30 days. Any measurement of steady-state release rates should be made during this initial 30-day exposure. An accepted procedure for this evaluation is provided in EPA's Call-In Notice of July 29, 1986 on tributyltin in antifouling paints under the Federal Insecticide, Fungicide and Rodenticide Act.

-- The definition of "Vessels" usually includes any ship, boat or watercraft used for transportation on water. If any other kind of structure is to be included in this definition, it should be defined as specifically as possible to avoid or prevent unintended interpretation.

-- Working with the American Society of Test Methodology, recent studies by the U.S. EPA show that a value of 5.0 micrograms will provide maximum antifouling protection while minimizing the impact to the aquatic environment. The studies associated with these findings identified procedural errors in the methodology used in earlier studies which yielded a value of 0.5 micrograms as an acceptable release rate.

-- For smaller recreational vessels (less than 25 meters) with fiberglass hulls available alternative antifouling paints can be used. In these situations, TBT based paints should not be allowed. Paints containing TBT that have an acceptable steady-state release rate should only be used on vessels exceeding 25 meters in length or that have aluminum hulls. Marine paints containing TBT should be prohibited on all other vessels. It would also be beneficial to allow the use of TBT paints of an acceptable release rate if used in a spray can of 16 ounces or less commonly referred to as an outboard or lower drive unit paint.

-- Containers of pure or concentrated TBT are readily available in many hardware and marina supply stores. These are labeled for mixing with marine paints by the consumer to produce a TBT based antifouling paint. This creates the potential for TBT to be mixed into paints which contain an alternative antifouling agent or into TBT paints with an acceptable release rate resulting in higher than allowed concentrations. Such mixing produces a paint containing TBT in a free association form which is regarded as the most toxic. Unless this usage is also restricted the effectiveness of any proposed legislation may be greatly reduced.

Maryland and Virginia have enacted legislation which is intended to prevent the addition of more tributyltin in the waters of the Chesapeake Bay. Natural processes in the restrictions being placed on the use of antifouling paints. The results obtained from the Chesapeake Bay monitoring program can be used to evaluate nationwide restrictions. Therefore, we believe that it would be most appropriate for federal agencies to support the Chesapeake Bay monitoring program.

Maryland strongly supports the need for national legislation to restrict the use of tributyltin in marine paints. In this respect, I very much appreciate the opportunity to share with you our experience with tributyltin. Speaking on behalf of Governor Schaefer, the Department of Natural Resources and other Maryland agencies would be most pleased to assist the Subcommittee in any way possible in the effort to enact this important legislation.

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State of Maryland
Executive Department
Washington Office
444 North Capitol St. NW #315
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William Donald Schaefer
Governor

April 22, 1987

The Honorable Barbara A. Mikulski
387 Russell Senate Office Building
Washington, D.C. 20510

Dear Senator Mikulski:

I am writing to you about federal legislation designed to restrict the use of Tributyltin (TBT), a commonly used boat paint that is toxic to marine life. I urge you to do everything you can to ensure that this legislation moves forward in the Congress as quickly as possible.

TBT is effective in preventing the build-up of marine organisms on the hulls of vessels. Unfortunately, TBT also has detrimental unintended consequences. TBT particles released from the paint on these vessels, even at very low levels, is extremely toxic to aquatic life. With the growing use of TBT, the need to restrict it has increased.

In response to concerns raised about the effects of this substance on aquatic species, the State of Maryland has taken action. The Maryland General Assembly recently passed legislation to severely restrict its use and level of concentration.

Since this is not just a Maryland problem but affects all coastal and inland waterways, I am pleased to see that legislation has been introduced in the Senate and the House to restrict the use of this substance nationwide. These bills, introduced by Senator Trible and Congressman Bateman, are similar in concept and scope to the legislation recently passed by the Maryland legislature.

The Senate and House measures are a significant step forward in our efforts to control the use of TBT. I urge the

Delegation to ensure swift consideration of legislation to alleviate the TBT problem. During consideration of TBT legislation, I urge you to support amendments to these proposals that would more effectively control the dangers of TBT.

First, I think it is imperative that we explore ways to effectively monitor the effect of these restrictions on our living resources. To do this, I would like to suggest an amendment to be included in the bill that would mandate a program to routinely analyze the water samples in important estuaries like the Chesapeake Bay.

Second, changes are needed in the method of calculating the amount of TBT that can be released in the water. In particular, the bill should require the measurement of TBT leaching during the first 30 days after the vessel is painted. We need to measure and regulate leaching during this initial 30 day period because this is when the greatest amount of TBT is released. As currently drafted, the bill does not begin measurement of TBT release rates until 30 days after the vessel has been placed in the water following the application of the paint.

In addition, the current proposals do not include adequate provision for standardization of release rate measurement. EPA has recently circulated a testing protocol for the measurement of TBT release rates. I recommend that this protocol be referenced in the legislation and that the EPA's release rate finding be adopted. This release rate was found by EPA to provide the maximum anti-fouling protection while minimizing environmental damage.

Third, the bills cover "Vessels," and include in that definition any ship, boat, watercraft or other marine structure. However, I believe that additional language should be included in the bill to define the term "marine structures".

Fourth, the bill currently requires that all TBT based paint used on vessels have an acceptable release rate. However, the bill fails to address the question of the appropriate uses for TBT based paints. Vessels with metallic hulls must use TBT based paint because other anti-fouling agents are chemically incompatible with the metals used in these vessels. However, there are many alternative anti-fouling agents that are effective for wood and fiberglass vessels that do not harm the environment. For this reason, I believe an amendment should be added to the legislation to prevent the use of TBT based paint on vessels under 25 meters in length with nonmetallic hulls.

Fifth, containers of concentrated TBT are readily available in many hardware and marina supply stores. They are labeled for mixing with marine paints by the consumer to produce a TBT based anti-fouling paint. This creates the danger that consumers will mix TBT with paint at concentrations far in excess of those permitted by the bill. The sale of concentrated TBT to consumers should be prohibited or the effectiveness of the proposed legislation will be greatly reduced.

I am pleased that the Senate Environment and Public Works Committee will be holding hearings on the Senate bill on April 29. I understand that the hearings will look at other uses of TBT, as well. In light of the importance of the issue to Maryland, I have asked Torrey Brown, Secretary of Natural Resources, to represent the state at this hearing and convey my views in more detail at that time.

I look forward to working with you on this important matter. If you have any questions, please call Randy Collins or Monica Healy of my Washington Office at 638-2215.

Sincerely,

William Donald Schaefer
Governor

Testimony of
the Commonwealth of Virginia

before the

Senate Committee on Environment and Public Works
Subcommittee on Environmental Protection

April 29, 1987

Control of Tributyltin-based Anti-Fouling Paints

Mr. Chairman, members of the committee, I am Velma Smith, a member of the Virginia State Water Control Board. I am standing in today for John Daniel, the Virginia Secretary of Natural Resources, who could not be here this morning. Secretary Daniel has asked me to convey to you his appreciation for this opportunity to state, for your record, Virginia's strong support for controlling tributyltin-based (TBT) anti-fouling paints.

The Commonwealth of Virginia has already taken a number of important actions with respect to TBT and has worked cooperatively with the Environmental Protection Agency and the State of Maryland, in particular, in light of our common interest in restoring one of America's premier natural resources, the Chesapeake Bay. We in Virginia are pleased to see Congressional interest in TBT, and we are confident that you and your colleagues here will appreciate the need for national action to further control the use of this toxic substance.

As you know, the extreme toxicity of TBT is the same property that makes it so useful as an ingredient in anti-fouling boat paint. TBT leaches into the water from the paint to kill or repel nuisance organisms such as barnacles before they attach themselves to the boat. The chief advantage of TBT over copper-based boat paints is its longer-lasting efficacy as a killer of marine organisms. This translates into less frequent hull scraping on the part of boat owners. Thus, it is not surprising to find that more than 70 percent of the recreational and commercial ships and boats in the world are painted with TBT paints.

Unfortunately, the popularity and the widespread use of the TBT paints combine with its toxicity to produce what we believe is a serious threat to our nation's harbors and waterways. Since you are receiving separate information from scientific experts on TBT's chemical nature and toxicity. I will not attempt to comment on the specifics of the research findings which Virginia has reviewed in development of its TBT policy.

Rather, I will comment from the perspective of a state official with responsibility for the overall health of the environment. Given this responsibility and given the information we have collected on TBT, the Virginia State Water Control Board has adopted a policy which we feel is well-founded and conservative. We have determined that it is not only unwise to continue to stress our sensitive and valuable marine ecosystems with increasing levels of TBT. It is also unnecessary to do so.

The threat from TBT can be described fairly simply. We have a highly toxic substance being used as boat paint. The unintended consequences of this use are the possible destruction of a variety of marine species, including those which are of significant importance to the natural health and diversity of our waterways, the nation's interstate commerce, and, for that matter, the nation's food supply.

The use of TBT is growing. And, left to itself, the problem will get worse. However, TBT has a comparatively short half-life in the environment. This means that reducing the amount of TBT entering the waterways by a sufficient amount will eventually eliminate the threat to our waterways. The questions that policy-makers must address in developing programs to reduce TBT releases are:

> What is a sufficient reduction to accomplish the task of water resource protection; and
>
> How do we reduce the amount of TBT entering our waterways?

In looking at those questions and the related question regarding who is in the position to initiate and implement the most effective reduction program, we conclude that the Federal government regulation of TBT use is clearly required in order to achieve the reduction necessary to eliminate the risk which TBT now poses. The problem of TBT control is a national problem; the waterways at risk deserve the protection that only the national government can provide.

Meanwhile, however, state actions are very much in order. In the case of TBT, Virginia has made a beginning which does part of the job of controlling TBT and which may demonstrate the types of governmental action needed to accomplish the task. I would like to discuss Virginia's actions with respect to TBT over the last year or two.

In 1985, when we first learned of the Navy's proposal to paint its fleet with TBT, Virginia led the way in pointing out information deficiencies and unresolved questions in the Navy's environmental assessment. We contacted other states, both those contemplated in the Navy's test painting program and others with reason to be concerned about toxic substances in their rivers and harbors. We learned quickly that TBT was not solely a Navy property or experiment, but a widely-used, popular ingredient of boat paint with an apparently high level of toxicity to marine organisms. We lost little time in joining forces with EPA and Maryland to ascertain what might be done, and in early 1986, we began sharing information on a regular basis concerning the extent of TBT in waters where our interests coincide, notably the Chesapeake Bay.

Research efforts of the Virginia Institute of Marine Science and the State Water Control Board indicate that, although we have not at this time documented an impact on marine life in the Chesapeake Bay from TBT, potentially harmful levels of TBT do occur in waters adjacent to our marinas and shipyards.

The Water Control Board is concerned about the data which indicate the presence of TBT in our waterways, the significant level of toxicity that appears to be associated with this chemical and the potential for bioaccumulation of TBT, and thus we have already announced our intention to establish a water quality standard for TBT. Selecting an appropriate number for this standard is not, unfortunately, an easy task, and it is made more difficult by the absence of Federal water quality criteria for TBT. We are anxiously awaiting an announcement of the criteria from EPA, however, and we hope to proceed as expeditiously as possible.

In addition, our State government made a systematic investigation of its own TBT use. As a result of that investigation, Virginia determined that the limited number of uses to which TBT had been put would be discontinued.

Late last year, following additional research concerning TBT effects on marine species, the Virginia Department of Agriculture and Consumer Services held an evidential hearing intended to give its Board a basis for reconsidering the state-level registration of TBT. As a result of data obtained through that review and other sources, Virginia has imposed significant restrictions on the use of TBT paints. The following requirements have been imposed through a combination of legislation and regulation.

Effective March 31, 1987, the use of TBT anti-fouling paint on boats shorter than 25 meters (82 feet) was prohibited unless the boat has an aluminum hull. Also effective on March 31 of this year, the use or sale of TBT in concentrated form as a paint additive was prohibited in Virginia.

Several additional actions become effective on July 1, 1987.

* TBT paint with an "acceptable release rate" may only be distributed, sold, or offered for sale to, or applied or possessed by commercial boat years;

* TBT paint with an "acceptable release rate" may be used only on boats over 25 meters or boats with aluminum hulls and may be applied only within a commercial boat yard;

* TBT paint with an "acceptable release rate" may be sold in spray cans of 16 ounces or less for aluminum fittings, outboard motors, and the like.

* The possession, distribution, sale, or use of TBT contrary to Virginia's new law is a Class 1 misdemeanor, punishable by a jail term up to one year or a fine up to $1,000 or both.

(Based on information available regarding test methods and the least toxic available paint formulations, Virginia has defined "acceptable release rate" as a measured rate of release not to exceed 5.0 micrograms per square centimeter per day as determined in accordance with EPA testing procedures.)

In addition, the Virginia General Assembly has gone on record urging Congress and the EPA to act to control releases of TBT and to support state efforts to develop regional solutions for reducing TBT discharges.

While state restrictions such as Virginia's can be very effective, particularly in limiting the adverse effects of TBT use associated with the multitude of small private boats, state restrictions alone cannot do the job. The interstate and international nature of commercial boat traffic demands that the Federal government play a significant role in controlling TBT.

We believe that Federal legislation should impose restrictions akin to those in Virginia's legislation and should set appropriate penalties for violations. It is important that Federal legislation include release rate restrictions as well as a ban on the use of all TBT-based anti-foulants on recreational vessels. Our information indicates that these recreational vessels are currently the major source of TBT residues in our waterways and present a particularly troubling problem, with significant releases concentrated in sheltered marinas and harbors which offer little natural ability for flushing and dilution of the chemical.

Finally, some attention to the international trade aspects of the problem must be reflected in a Federal law. We believe that it would be fully appropriate for the United States to seek commitments from other nations to limit or ban TBT paint; some other countries, such as Britain and France, have already taken steps in this direction. At the state level, we cannot address such matters.

I hope that this brief background on the measures which Virginia has taken to protect its natural resources will be helpful to the members of this Committee in your efforts to develop an appropriate Federal response to the threats posed by TBT. I thank you for this opportunity to testify, and I would be happy answer any questions which you may have.

TESTIMONY CONCERNING THE USE OF TRIBUTYLTIN IN MARINE ANTIFOULING PAINTS BEFORE THE U. S. SENATE COMMITTEE ON THE ENVIRONMENT AND PUBLIC WORKS - APRIL 29, 1987

by

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April 29, 1987

TESTIMONY CONCERNING THE USE OF TRIBUTYLTIN IN MARINE ANTIFOULING PAINTS BEFORE THE U. S. SENATE COMMITTEE ON THE ENVIRONMENT AND PUBLIC WORKS - APRIL 29, 1987

Initially, we wish to extend our appreciation to the U. S. Senate Committee on the Environment and Public Works for allowing Devoe Marine Coatings Co. to present our views on this most important and sensitive issue. For your information Devoe Marine Coatings Co., headquartered in Louisville, Kentucky, is a worldwide marine coatings manufacturer. Within the United States marine market, we are one of two predominant manufacturers.

With respect to the potential environmental and suspected human health problems associated with tributyltin (TBT), we feel that these subjects should be left to experts in the respective fields. However, there are several other issues regarding the TBT controversy which we are compelled to discuss.

The most significant issue we wish to address concerns the availability of alternatives to TBT containing antifoulings. There are those who claim that there are no alternatives to TBT antifoulings in general and to the TBT copolymer in particular. There are those who claim that a ban on TBT would cause economic duress to the shipping, ship repair and shipbuilding industries and would affect national defense. These allegations are simply not true. Why? Because the technology does presently exist to maintain all of the benefits previously associated with TBT antifoulings without utilizing TBT.

For the purposes of this discussion, there are two general categories of TBT antifoulings: conventional technology antifoulings and the state-of-the-art ablative and copolymer technologies. These technologies will be discussed further in this testimony. However, with respect to the conventional technology, virtually all marine paint companies possess and have marketed for years a complete line of conventional tin-free, non-ablative/non self-polishing antifoulings. In the area of TBT-free ablative and copolymer technologies we are aware of at least three major marine paint manufacturers who possess TBT-free products. One of these manufacturers possessing TBT-free ablative technology is a proponent of TBT--International Paint Company. International Paint markets a TBT-free ablative antifouling under the BRA 540/542 label and has applied this product to a number of U. S. Navy vessels. Additionally, we understand that a fourth manufacturer anticipates EPA approval on a TBT-free copolymer imminently. The largest manufacturer of TBT utilized in marine antifouling paint possesses two U. S. patents for TBT-free copolymers. These patents numbered 4,593,055 and 4,594,365 were granted to M & T Chemicals in June 1986. Furthermore, we are aware of at least two marine paint manufacturers who market non-toxic, non-TBT containing antifouling with at least two others in development. As far as we know nearly all of the other marine paint companies are expending research and development time/dollars in the development of additional TBT-free antifoulings. Therefore, it is obvious to a reasonable individual that TBT-free alternatives do exist in the marketplace today and that claims to the contrary are false.

In the conventional technology, Devoe Marine has marketed a line of highly effective TBT-free antifoulings for many years. With respect to the ablative/copolymer technologies, we have had a TBT-free ablative antifouling in the market for nearly four years. This product has been successfully applied to millions of square feet of underwater hulls of U. S. Navy, Military Sealift Command, Coast Guard, commercial and recreational vessels. These applications range from tug boats to tankers and aircraft carriers to nuclear submarines. Seven years of research and development, independent laboratory testing and four years of actual shipboard experience with this product has revealed performance that equals or exceeds the performance of the TBT copolymers. This technology will provide the 5+ years foul-free protection claimed by the TBT copolymer.

When a customer purchases antifouling paint for his vessels, his sole concern is whether or not the antifouling paint works - will it provide the antifouling properties he requires? His interest is in the performance of the product. It is an extremely rare customer who possesses sufficient knowledge to even inquire regarding the chemistry of the product. The bottom line is does the product protect his vessel's bottom? It would seem that the best judge of the performance of a product is the marketplace. With respect to our market and our products, the marketplace has passed judgment on the efficacy of TBT-free antifoulings which verifies our performance statements. Over the past several years we have seen the sales of TBT-free antifoulings experience significant growth to a point where the majority of antifoulings we sell are tin-free. This growth has been achieved because the performance of the TBT-free antifoulants has equalled or exceeded that of their TBT containing counterparts.

It should now be apparent that the argument against a ban on TBT based on non-availability of proven TBT-free alternatives is without foundation. The technology does exist and has existed for quite some time to eliminate TBT antifoulings.

The second issue we wish to discuss involves "acceptable release rates" and the availability of products which meet various release rate criteria. As you are aware, the U. S. Environmental Protection Agency is in a Special Review Process regarding TBT. The EPA issued a Data Call-In Notice to all manufacturers of registered TBT antifoulings which required manufacturers to submit certain data. One item of the data required was to furnish TBT release rates determined in accordance with a test method prescribed by the EPA. Devoe Marine engaged the services of an independent laboratory to conduct these tests. A number of antifouling formulations were tested with the result being that all formulations tested fell below 5.0 micrograms/square centimeter/day. In fact, 67% of the formulations tested had release rates below 1.0 micrograms/square centimeter/day. The formulations with release rates below 1.0 represents the gamut of available technology - from the low end products to the state-of-the-art products. Although we cannot speak for other manufacturers we can state that there are effective products available in the market with TBT release rates below 1.0 micrograms/square centimeter/day.

The third issue we wish to discuss concerns the manner in which TBT is incorporated into the paint and the TBT release rates of each type of paint. There have been many references in the national and state debates regarding the "free-association", copolymer and ablative antifoulings. In order to understand these references it is necessary to discuss the three technologies.

In the "free-association" antifoulings, the organotin compound is physically dispersed into the paint. Antifouling properties are achieved by the diffusion of the organotin out of the paint film or matrix. The release of TBT is basically an uncontrolled release as compared to the copolymer and ablative technologies. In the copolymer type antifoulings, TBT is reacted with an acrylic acidic monomer to form a copolymer. TBT is released in a controlled manner by the hydrolysis of the copolymer in water. This hydrolysis along with the "self-polishing effect" caused by the motion of the vessel through the water causes the exposure of fresh layers of TBT, i.e., the old paint sloughs off or wears away. However, it should be noted that many copolymer type antifoulings require the addition of "free TBT" in order to provide for stability of the coating in the can in the presence of cuprous oxide, i.e., it is necessary to prevent the paint from gelling in the can. This "free TBT" that is added in some of the copolymers is TBT which is not chemically reacted with other components of the paint--in essence, it is "free association TBT." In ablative antifoulings, TBT is chemically reacted with various ingredients to form a resin complex. The mechanism upon which TBT is released is very similar to the copolymer technology, i.e., hydrolysis of the paint film and the ablative action or wearing away of the coating as the vessel passes through the water.

Many individuals were of the opinion that the "free-association" antifoulings would have a higher TBT release rate than the copolymers and ablative types. However, based on independent laboratory tests, we have found this to be incorrect. We have found that a "free-association" antifouling can have a substantially lower initial and steady state release rate than certain copolymer formulations. In one case, the initial release rate of a copolymer was over 600% higher than a "free-association" formulation and 56% higher at steady state conditions. We believe this may be due to the addition of "free TBT" to which we previously referred.

The purpose of the above is to show that the manner in which TBT is incorporated into the paint or whether the paint is a "free-association", copolymer or ablative type has little bearing on the initial and steady state release rates.

We anticipate that testimony will be given regarding a "change in formulation" in the cuprous oxide based tin-free ablative antifouling which the U. S. Navy has been using for approximately four years. The product in question is manufactured by Devoe Marine. While it is true that a minor formulation change was made in the TBT-free ablative antifouling, it was made at the suggestion of the Navy. The Navy accepted and approved the minor formulation change based on the equivalent performance of the product to the original and has continued to use the product. There are two important points which must be raised. Firstly, minor formulation changes are common practice throughout the paint industry. Secondly, the formulation change does not affect the antifouling efficacy. This fact has been confirmed by independent testing facilities.

In conclusion, we summarize our testimony as follows:

First, and most important, the technology does presently exist, has existed for a number of years and is available in the marketplace today from several manufacturers to eliminate TBT while maintaining all the economic and performance benefits previously associated with TBT and simultaneously eliminating and/or significantly reducing the potential environmental and human health problems which have been associated with TBT.

Second, products are available in the marketplace today which possess release rates below 1.0 micrograms/square centimeter/day.

Third, any restrictions placed on TBT antifoulings should be based on meeting the "acceptable release rates" and not on the basis of "free association", copolymer or ablative technologies.

Devoe Marine Coatings Co. wishes to thank the Senate Committee on the Environment and Public Works for allowing us to present this testimony.

SUPPLEMENTAL TESTIMONY SUBMITTED TO U. S. SENATE COMMITTEE ON THE ENVIRONMENT AND PUBLIC WORKS, SUBCOMMITTEE ON ENVIRONMENTAL PROTECTION IN CONNECTION WITH THE HEARING ON TRIBUTYLTIN USE IN MARINE ANTIFOULING PAINT (SENATE BILL S.428) WHICH WAS HELD ON APRIL 29, 1987

by

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SUPPLEMENTAL TESTIMONY SUBMITTED TO U. S. SENATE COMMITTEE ON THE ENVIRONMENT AND PUBLIC WORKS, SUBCOMMITTEE ON ENVIRONMENTAL PROTECTION IN CONNECTION WITH THE HEARING ON TRIBUTYLTIN USE IN MARINE ANTIFOULING PAINT (SENATE BILL S.428) WHICH WAS HELD ON APRIL 29, 1987

Devoe Marine Coatings Co. appreciates having the written testimony we submitted on April 29, 1987 via Senator Paul Trible's office introduced into the official record of the Tributyltin (TBT) Hearing held by the Senate Subcommittee on Environmental Protection. We feel that additional comments are necessary in connection with the TBT controversy in order to provide supplemental information to the Committee, to correct inaccuracies in testimony given by others and to present alternate views by a member of the marine paint manufacturing industry. We wish to address the following points:

1) COPOLYMER vs. ABLATIVE TECHNOLOGY

There appears to be a degree of confusion regarding the terms "ablative" and "self-polishing copolymers." In this section we will present information to clarify these definitions.

The present state-of-the-art antifoulings are represented by those coatings which wear away/polish/ablate away. This technology is represented by both the self-polishing copolymers and ablative antifoulings. In the maritime community the terms "self-polishing copolymer" and "ablative" are recognized and used synonymously. When specifications are prepared by shipowners and the U. S. Navy calling for the state-of-the-art antifoulings they are described as either ablative or self-polishing copolymer antifouling. The vessel owner's interest is to describe the type of antifouling paint which wears or ablates away, provides a smoothing/polishing effect and further provides long term antifouling protection. The terms "ablative" and "self-polishing copolymer" are used interchangeably to describe antifouling coatings meeting these requirements.

From a technical perspective, there are many similarities between the state-of-the-art ablative technology and the self-polishing technology which have led the marketplace to use these terms analogously. In both types of antifouling, TBT is chemically reacted with other ingredients in the paint. The mechanism upon which the biocide is released is similar. In both technologies, biocides are released in a controlled, engineered manner by the hydrolysis of the paint film in seawater. In conjunction with this hydrolysis, fresh layers of biocide are exposed in both technologies due to the ablative or self-polishing action caused by the motion of the vessel through the seawater, i.e., the old paint sloughs off or wears away exposing fresh layers of paint. Both technologies provide smoothing of the vessel's underwater hull and are designed for 5+ years foul-free protection.

In order to simplify the above, Exhibit 1 is attached. This exhibit is a photograph of the starboard side stern underwater area of a large tanker on drydock. The bottommost area, indicated by the number "2", was coated with a three coat TBT self-polishing copolymer antifouling manufactured by one of the largest marine coating suppliers. You will observe three distinct colors in this section of the vessel which relate to each of the three coats of copolymer. The small areas which are "off-white" represent the first coat of copolymer, the light gray is the second coat and the blue/green is the top coat. Although it may not appear so to the untrained eye, this system is working as designed. The blue/green top coat wears away as discussed above exposing the light gray intermediate coat of copolymer. As the light gray wears away, the off-white copolymer is observed. The wearing action continually provides exposure of "fresh paint" complete with exposure of fresh biocide.

As stated above, the mechanism upon which the state-of-the-art ablative antifouling functions is very similar to that of the self-polishing copolymer: hydrolysis of the paint film in seawater and the exposure of fresh layers of paint via the motion of the vessel through the water. This fact is evidenced by the section marked with the number "1" on Exhibit 1. This area was painted with a two coat ablative antifouling. The first coat is blue and the top coat is red. Again, it can be observed that the top coat (red) has begun to ablate away exposing the blue first coat. When the copolymer (Area "2") is compared to the ablative antifouling (Area "1") the similarities between the two technologies become quite apparent.

Another parallel between the ablative and copolymers involves the steps necessary to renew the antifouling when the vessel is drydocked. In both technologies abrasive blasting is not required. It is expected that the condition of the underwater hull of a vessel upon subsequent drydocking is exemplified by Exhibit 1. All that is necessary for both technologies is a high pressure water wash followed by reapplication of the antifouling.

It should now be obvious that, due to the vast similarities, the terms "ablative" and "self-polishing copolymer" are synonymous.

There are, however, two significant differences between the technologies. Firstly, many copolymer type antifoulings require the addition of "free-TBT" in order to provide for stability of the coating in the can, i.e., it is necessary to prevent the paint from gelling in the can. This "free TBT" that is added in many of the copolymers is TBT which is not chemically reacted with other components of the paint--in essence, it is "free-association TBT." Secondly, independent laboratory tests have shown that the initial and steady state TBT release rates for copolymer antifoulings are significantly higher than those of ablative antifoulings. We have scientific data which indicates that there are copolymer formulations which exhibit an initial TBT release rate approximately 180% to over 600% higher than an ablative technology and an average steady state release rate over 30% higher. We believe this may be due to the addition of "free TBT" to which we previously referred. One of the major impacts of the copolymer's significantly higher release rate may be in that time period when a newly painted vessel is taken off drydock. At this point, the vessel is normally moored in a shipyard for a period of time until the remainder of the repairs are completed. During this stationary period a vessel with a newly painted copolymer antifouling could literally be flooding the environment with TBT due to the previously discussed extremely high initial TBT release rates. Furthermore, at steady state conditions, the copolymer technology antifoulings would contribute significantly higher quantities of TBT into the water than the ablative antifoulings.

Ablative antifoulings have been applied to hundreds of vessels. Actual shipboard experience has verified independent research tests and reveals that the performance of the ablative antifoulings equals or exceed the performance of self-polishing copolymers. Exhibit 1 is a side by side comparison of the ablative and copolymer technologies. It should be noted that both areas are foul-free. The ablative technology has already provided 5+ years foul-free protection in actual applications. The oldest application of ablative antifouling is nearly 6 years old and still performing.

Our knowledge of the ablative and copolymer technologies is based on years of research and development, independent laboratory tests and actual shipboard experience.

Based on the above, any claims inferring that the ablative technology is not state-of-the-art or that ablative antifoulings do not wear away or that ablative antifoulings do not provide long term protection are incorrect.

2) EXISTENCE OF COPPER BASED TBT-FREE COPOLYMER (ABLATIVE) ANTIFOULINGS

Testimony was given at the hearing by International Paint in response to direct examination by Senator Paul Trible that copper based (TBT-free) copolymers do not exist. This statement is incorrect. We believe that this response straddles the semantics between the terms "ablative" and "copolymer." If one accepts that "ablative" and "self-polishing copolymer" are synonymous terms in the marketplace as discussed in Section (1) above, then this testimony is incorrect in that International Paint Co. markets a TBT-free, copper based ablative antifouling. Even if one does not accept ablative and self-polishing copolymer as analogous, International Paint did not advise the Committee regarding the existence of their copper based, TBT-Free ablative antifouling when questioned by the Committee concerning alternatives to TBT copolymers. A copy of International Paint's BRA Series Tin Free Ablative Antifouling Technical Data Sheet is attached as Exhibit 2.* This product has been applied to a number of U. S. Navy and Military Sealift Command vessels over the past year and has just been applied to the nuclear aircraft carrier USS Theodore Roosevelt at Newport News Shipbuilding and Drydock. Additionally, M & T Chemicals, the largest manufacturer of TBT for use in marine antifoulings, has held patents numbered 4,593,055 and 4,594,365 for two TBT-free copolymers for approximately one year. Devoe Marine has marketed a copper based TBT-free ablative antifouling for over four years. We understand that at least two other major marine manufacturers possess TBT-free copper based ablative/copolymer antifoulings. Moreover, in the area of conventional copper based antifoulings, nearly every major marine paint manufacturer has had this product line for many years.

Therefore, it is obvious to a reasonable individual that copper based TBT-free ablative/copolymer antifoulings do exist today.

3) ALLEGED ECONOMIC IMPACT

Representations were made to the Committee concerning the devastating economic and national defense implications which would arise if TBT was banned. We disagree with these statements for the following reasons.

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*This exhibit has been retained in committee files.

We believe that these statements were made based on an invalid comparison between the TBT copolymers and conventional antifoulings. Conventional antifoulings provide only approximately two years protection and do not provide the hull smoothing and fuel savings associated with TBT copolymer and ablative antifoulings. Based on this premise, claims of economic duress may be true; however, it completely discounts the existence of alternative, proven, high performance TBT-free copper based ablative antifoulings. TBT-free ablative antifoulings do exist and have existed for a number of years and are available from several manufacturers. These copper based ablative antifoulings provide all the economic benefits previously associated with TBT copolymers including hull smoothing, fuel savings, maintenance savings, 5+ years foul-free protection, etc., without utilizing TBT.

By comparing the TBT copolymer with conventional antifoulings, one is comparing a Volkswagen to a Cadillac -- it is an invalid comparison. Furthermore, as previously stated, we believe this invalid comparison was the basis for the testimony presented at the Hearing concerning economic duress and national defense implications. When one properly compares the TBT copolymer to the copper based TBT-free ablative/copolymer antifouling, an "apples to apples" comparison is achieved. Testimony presented to the Committee regarding economic duress and national defense implications must be based on correlations between the TBT copolymer/ablative antifoulings versus the TBT-free copper based ablative/copolymer antifoulings and not on comparisons with conventional antifoulings. We must stress the point that when the proper comparison is made there is no adverse economic effects because proven alternatives to the TBT copolymer do exist in the form of TBT-free copper based ablative antifoulings. These products maintain all of the benefits of TBT copolymers without utilizing TBT.

4) EFFECTIVENESS AND USE OF COPPER BASED TBT-FREE ABLATIVE ANTIFOULINGS

As discussed in the previous sections, a number of marine paint manufacturers possess copper based TBT-free ablative/copolymer antifoulings. In order to address the effectiveness of the copper based TBT-free ablative antifoulings we will discuss our product since, obviously, it is the product with which we are most familiar. After approximately seven years of research and development, Devoe Marine introduced a copper based TBT-free ablative antifouling in early 1983. The first application of this product was on the USS BARNEY (DDG-6) and was applied in May 1983. In the past four years the copper based TBT-free ablative antifouling has been successfully applied to over 80 vessels covering millions of square feet of underwater hull area on U. S. Navy, Military Sealift Command, U. S. Coast Guard, commercial, and recreational vessels. These applications range from tug boats to tankers and nuclear submarines to aircraft carriers. The four years actual shipboard experience with the copper based TBT-free ablative antifouling coupled with years of independent research facility testing has revealed performance that equals or exceeds the performance of the TBT copolymer.

In May 1983, a test patch of TBT-free copper based ablative antifouling and test patches of four TBT copolymer/ablative antifoulings were applied to the USS BARNEY (DDG-6). After three years service, this vessel was drydocked for emergency reasons. A survey of the underwater hull area revealed that the performance of the copper based TBT-free ablative antifouling equaled and in one case exceeded the performance of the TBT copolymers. Exhibit 3* is a survey report regarding this inspection. This vessel has now been in service four years and the copper based TBT-free ablative antifouling is performing as designed.

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*This exhibit has been retained in committee files.

Exhibit 4 is a photograph of a panel of the copper based TBT-free ablative antifouling after 42 months exposure at an independent research facility. You can observe the complete absence of fouling on the panel. Please note that the damage to the panel in way of the edges was caused by the racks in which the panel is contained and is not indicative of a failure.

Exhibit 5 is a performance comparison between the copper based TBT-free ablative antifouling (left panel) and one of the leading TBT copolymers (right panel) after exposure at an independent research facility. You can observe the fouling present on the TBT copolymer and the completely foul free performance of the copper based TBT-free ablative antifouling.

Exhibits 6, 7 and 8[*] are letters from customers who have experience with both copper based TBT-free ablative antifouling and TBT copolymer/ablative antifoulings. These exhibits provide marketplace credibility to our claims concerning the performance of the copper based TBT-free ablative antifouling.

The above information and attached exhibits clearly demonstrates that the performance of the TBT-free copper based ablative antifouling equals, and in some cases exceeds, the performance of the TBT copolymer. Therefore, any claims stating that copper based TBT-free ablative alternatives to TBT copolymers do not provide equivalent performance are unfounded.

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[*] These exhibits have been retained in committee files.

5) COPPER BASED TBT-FREE ABLATIVE ANTIFOULINGS WILL PROVIDE LONG TERM FOULING PROTECTION

Testimony was presented to the Committee regarding the ability of copper based TBT-free ablative antifouling to provide long term protection from fouling organisms. Copper based TBT-free ablative antifoulings will provide long term protection.

The ability of an ablative antifouling to provide long term foul free protection is a function of its antifouling properties, ablation rate and film thickness (thickness of the paint). If the antifouling paint maintains a foul free underwater hull due to its composition, formulation and ablation rate (as is the case with the copper based TBT-free ablative antifoulings), the length of time of satisfactory performance becomes a function of paint film thickness. If sufficient thickness of antifouling paint is applied consistent with its designed ablation rate, the required number of years of foul free performance is achievable. In other words, due to the ablation mechanism, the effective life of the ablative antifouling is predictable via adjustment of the antifouling paint thickness applied.

We have established the antifouling efficacy and ablation of the copper based TBT-free ablative antifouling paints. We have established that TBT-free copper based ablative antifoulings have been in service for four years and continues to perform as designed. This technology has been utilized on over 80 vessels over the past four years. We have seven years of research and development experience. Even International Paint's BRA Series Tin Free (copper based) Ablative Antifouling (See Exhibit 2) is described in their literature as "an economical antifouling to offer fouling protection for extended periods of time."

Based on the above, Devoe Marine has no qualms concerning the ability of the copper based TBT-free ablative antifouling to provide the 5+ years protection required by the U. S. Navy. In fact, Devoe Marine has provided the Navy with a guarantee covering a period of up to 5 years to this effect. This technology will provide long term antifouling protection consistent with the needs of the U. S. Navy and commercial shipowners.

6) TBT IS NOT THE MOST EFFECTIVE BIOCIDE AGAINST FOULING

The statement that TBT is the most effective chemical agent against fouling has been made by the "pro-tin" interests many times. We disagree with this statement. Our research indicates that when copper and TBT are directly and individually compared with respect to their antifouling capabilities, copper is superior to TBT. The references made to the long term fouling protection achieved with TBT are misleading. Again, the basis for this statement has been to improperly compare TBT copolymers to copper based conventional antifoulings. As stated in previous sections, this is a "Volkswagen to Cadillac" comparison. The superiority of the TBT copolymer versus conventional antifouling lies not in the use of TBT but in the ablative action of the coating. The long term fouling protection is a function of the ablation rate of the coating. It is the ablation of the paint film which provides the longevity and not the TBT. This fact is verified by our research which proves that the performance of the copper based TBT-free ablative antifouling equals or exceeds that of the TBT copolymer. When the performance of the TBT copolymer is properly compared to the copper based ablative antifouling and not to copper conventional coatings, the statement that TBT is the most effective chemical agent against fouling is untrue.

7) FORMULATION CHANGE IN COPPER BASED ABLATIVE ANTIFOULING DOES NOT AFFECT EFFICACY

We believe that additional testimony will be given regarding a "change in formulation" in the copper based TBT-free ablative antifouling which the U. S. Navy has been using for approximately four years. The product in question is manufactured by Devoe Marine. While it is true that a minor formulation change was was made in the copper based TBT-free ablative antifouling, it was made at the suggestion of the Navy. The Navy accepted and approved the minor formulation change based on the equivalent performance of the product to the original and has continued to use the product. There are two important points which must be raised. Firstly, minor formulation changes are common practice throughout the paint industry. Secondly, the formulation change does not affect the antifouling efficacy. This fact has been confirmed by independent testing facilities.

The acceptance of a formulation change by the Navy is not unprecedented. One of the TBT copolymers which the Navy intended to utilize prior to its prohibition by Congress was a result of formulation changes and reformulation of an existing product. Although this product contained formulation differences from the product originally tested, the Navy approved its use. As far as we know, this product has only been in service for approximately three years in a full vessel application--less time than the copper based TBT-free antifouling.

The bottom line is that the minor formulation change did not affect the efficacy of the product.

8) TBT RELEASE RATES OF FREE ASSOCIATION vs. COPOLYMER

Testimony was given to the Subcommittee that the free-association antifoulings release markedly higher amounts of TBT into the environment than copolymers. Based on independent laboratory tests measuring the TBT release rates of various antifoulings, this is not necessarily correct. We have found that a free-association antifouling can have a substantially lower initial and steady state release rate than certain copolymer formulations. In one case, the average initial release rate of a copolymer was over 600% higher than a free-association formulation and 56% higher at average steady state conditions. We believe this may be due to the addition of "free-TBT" to which we previously referred to in Section 1 of this document. Also, we understand that the testimony of Dr. John A. Moore, Assistant Administrator for Pesticides and Toxic Substances of the Environmental Protection Agency to the Subcommittee on April 29, 1987 stated that one of the lowest TBT release rates was possessed by a free-association formulation.

The purpose of the above is to show that whether the paint is a free-association or copolymer formulation has little bearing on the TBT release rates. Copolymers can have higher TBT release rates than free-association antifoulings.

In conclusion, we summarize our testimony as follows:

A) FIRST, AND MOST IMPORTANT, THE TECHNOLOGY DOES EXIST, HAS EXISTED FOR A NUMBER OF YEARS AND IS AVAILABLE IN THE MARKETPLACE TODAY FROM SEVERAL MANUFACTURERS TO ELIMINATE TBT WHILE MAINTAINING ALL THE ECONOMIC AND PERFORMANCE BENEFITS PREVIOUSLY ASSOCIATED WITH TBT AND THE TBT COPOLYMER.

B) FROM THE PERSPECTIVE OF THE MARKETPLACE, THE TERMS COPOLYMER AND ABLATIVE ARE SYNONYMOUS.

C) COPPER BASED, TBT-FREE COPOLYMER/ABLATIVE ANTIFOULINGS DO EXIST IN THE MARKETPLACE.

D) STATEMENTS REGARDING ECONOMIC DURESS AND NATIONAL DEFENSE IMPLICATIONS ARE INCORRECT IN THAT INVALID COMPARISONS FORM THE BASIS FOR THESE STATEMENTS. WHEN THE PROPER COMPARISONS ARE MADE THERE ARE NO NEGATIVE ECONOMIC OR NATIONAL DEFENSE PROBLEMS.

E) THE PERFORMANCE OF COPPER TBT-FREE ABLATIVE ANTIFOULINGS EQUALS OR EXCEED THE PERFORMANCE OF THE TBT COPOLYMER.

F) COPPER BASED TBT-FREE ANTIFOULINGS WILL PROVIDE LONG TERM PROTECTION FROM FOULING. IT WILL PROVIDE THE 5+ YEARS PROTECTION REQUIRED BY THE NAVY AND COMMERCIAL SHIPPERS.

Devoe Marine believes that the potential environmental and health problems which are allegedly associated with TBT should be left to experts in the respective fields. HOWEVER, WE WISH TO STRESS THAT THE SOLUTION PRESENTLY EXISTS - THE CONTROVERSY CAN BE ELIMINATED WHILE MAINTAINING ALL PRIOR BENEFITS.

Devoe Marine Coatings Co. wishes to thank the Committee for allowing us to present this supplemental testimony and respectfully requests that this document be introduced into the record. Should you have any questions or require additional information, please feel free to contact us.

¶ ¶ ¶ ¶

EXHIBIT 1

ABLATION OF COPOLYMER vs. ABLATIVE ANTIFOULING

EXHIBIT 4

COPPER BASED TBT-FREE ABLATIVE ANTIFOULING

42 MONTHS EXPOSURE

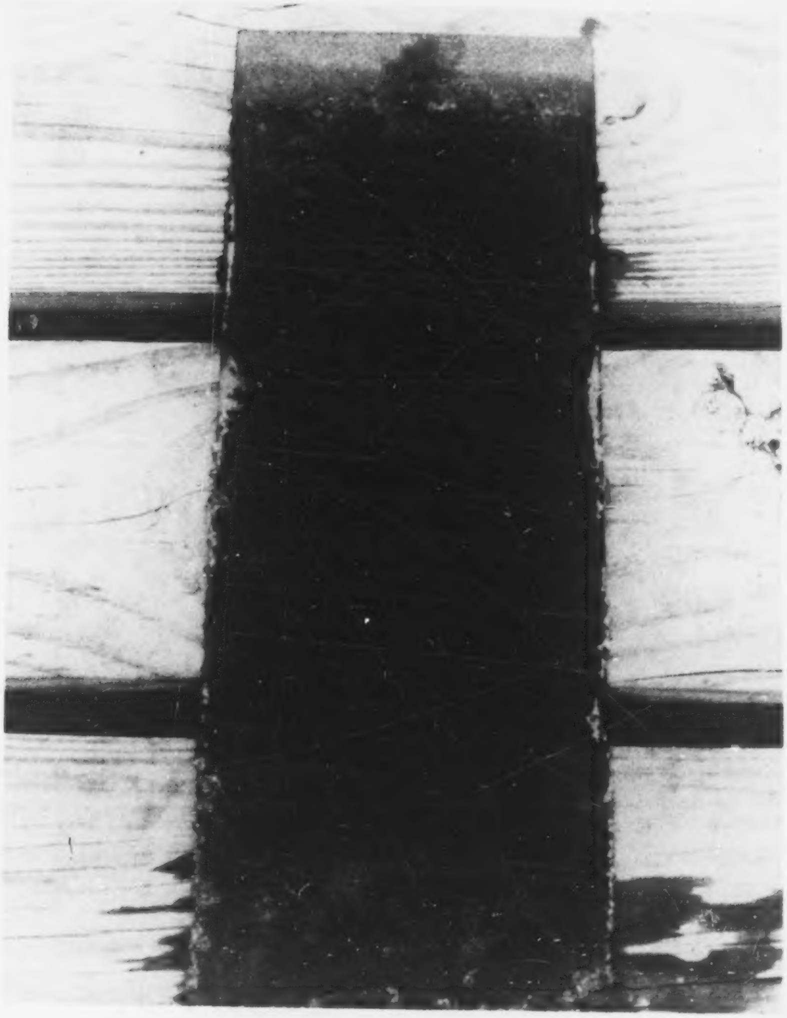
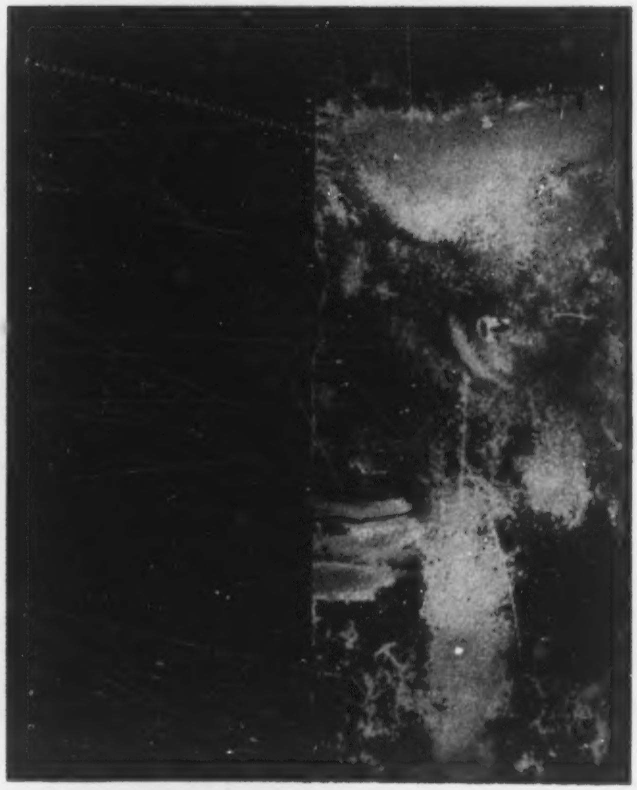


EXHIBIT 5

COPPER BASED
TBT-FREE ABLATIVE
ANTIFOULING
(Left Panel)

COPOLYMER
CONTAINING TBT
(Right Panel)



NOTE FOUL FREE PERFORMANCE OF COPPER BASED TBT-FREE ABLATIVE ANTIFOULING AND THE FOULING PRESENT ON THE TBT COPOLYMER.

ENVIRONMENTAL DEFENSE FUND

1108 East Main Street
Richmond, VA 23219
(804) 780-1297

April 23, 1987

The Honorable George Mitchell
United States Senate
Washington, D.C. 20510

Re: Tributyltin Comments to the Senate Subcommittee on Environmental Protection

Dear Senator Mitchell:

Please find enclosed the comments of the Environmental Defense Fund (EDF) submitted for consideration by the Senate Subcommittee on Environmental Protection at its April 29, 1987, hearing on tributyltin (TBT).

EDF is very concerned about the use of TBT in marine antifoulant paints and urges the Subcommittee to strongly consider national legislation to regulate the use of this compound.

We hope that the enclosed document is helpful to the Subcommittee in its deliberations and will provide a framework for future legislation. EDF would be happy to provide any further information that may be needed or assist the Subcommittee in any way.

Thank you for this opportunity to submit comments.

Yours truly,

David S. Bailey

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COMMENTS OF THE ENVIRONMENTAL DEFENSE FUND

SUBMITTED TO THE

SENATE SUBCOMMITTEE ON ENVIRONMENTAL PROTECTION

April 29, 1987

The Environmental Defense Fund (EDF) is a not-for-profit national environmental organization dedicated to the elimination of unintentional exposure to toxic materials. EDF has over 50,000 members and six offices nationwide, operating on an annual budget of over five million dollars. Since its founding in 1967 to seek controls over the use of the pesticide DDT, EDF has had a long history of scientific and legal interest in toxic issues. EDF first became interested in tributyltin (TBT) nearly two years ago when the United States Navy indicated its intention to coat the entire fleet with an antifoulant paint containing TBT compounds. During our initial review of the compound, EDF scientists became immediately concerned over published reports of TBT's toxicity and ability to bioconcentrate. These concerns were heightened by a proposed product use whose very application contemplated significant exposure for nontarget species.

This submittal addresses three particular parts of the overall TBT picture: the environmental threat from TBT releases, the alternatives available, and the regulatory role that is essential at this time. It is our hope that these comments will convince you that TBT is a very serious threat to marine resources, that alternatives are available for most needs and that immediate regulation of these compounds is imperative.

TBT Toxicity

Marine coating manufacturers are attracted to TBT because of its great toxicity to marine fouling organisms. Indeed, TBT formulations presently used in marine antifoulant applications are as toxic, or more so, than many other pesticides now banned or severely restricted in their application. Nearly all important TBT toxicity test results for marine organisms are measured in the parts per trillion (pptr) range; concentrations of one part per billion (ppb) or more are acutely toxic to most all sensitive species. Chronic effects, including serious developmental and reproductive abnormalities, occur at very low exposure levels.

Studies have shown that the American oyster and the hard clam, Mercenaria, both common to the U.S. Atlantic coast, die upon exposure to one ppb TBT, and significant developmental problems are demonstrated at exposures of 770 pptr (13). The Pacific oyster, presently beginning a comeback on our Pacific coast, is more sensitive to TBT, suffering larval mortality rates of 60% after 45 days' exposure to only 240 pptr TBT (18).

Oysters which manage to survive acute exposures to TBT do not continue to develop normally. TBT appears to interfere with calcium metabolism, resulting in unusual chambering in the oyster shell. This phenomenon is most evident in the Pacific oyster, which develops such massive shell malformations that shell development expands dorso-ventrally rather than laterally, as in normal growth. This effect is called "balling" and virtually destroys oyster marketability due to poor meat development. First noted in France, these malformations were duplicated in tests performed in California by exposing Pacific oysters to 300-900 pptr TBT over a period of three months (17)(18).

Other aquatic species, important components of the marine food chain, are adversely affected by low levels of TBT. Larvae of Gammarus, a small shrimp, experienced reduced survival upon exposure to 300 pptr (12); copepods, small crustaceans, were killed by exposures to 500 to 1,000 pptr (19)(7); all adult mysid shrimp exposed to 400 pptr died within one week (3). Developmental deformities have been found in crabs exposed to 500 pptr (22). Studies in England have postulated that levels of TBT as low as 1-2 pptr may cause a high degree of imposex (development of male sex characteristics and concomitant infertility in the female) in the dogwelk, a small marine snail (2). Such effects are believed to be a major factor in the marked decline of this marine snail in certain areas of England (2).

Marine species along both U.S. coasts are presently exposed to TBT levels recognized as toxic by the general scientific community. In Virginia, for example, surveys of marina and harbor areas in 1986 found that TBT values averaged over 200 pptr, with peaks of 700 pptr or more (12). Sampling of Maryland marinas in 1985-86 showed peak concentrations exceeding 1000 pptr (6). Areas of heavy ship traffic in Virginia have exceeded 900 pptr; even large deep water channels routinely contain 10-20 pptr TBT (20). Similar values can be found in many marinas and harbors on both coasts, even in major freshwater seaways (7). Surveys in California have documented the decline, or in some cases the total absence, of shellfish in harbors contaminated with 100-300 pptr TBT (16).

Direct toxicity to marine organisms is not our only concern. TBT is concentrated in fish and shellfish tissue and could pose a threat to consumers. Analytical techniques to accurately measure tissue concentrations of TBT are still developing, but we do know that bioconcentration occurs and can reach levels of concern for human consumption. Studies in Alaska, where salmon are raised in TBT-treated pens, have shown TBT residues in salmon tissue, and TBT-tainted salmon have been identified from consumer markets in Washington State and Oregon (14). These same studies indicate that TBT is not destroyed during normal food preparation. California has confirmed levels of several parts per million TBT in oysters taken from their coastal waters (16).

TBT does have a relatively short half-life in the water, about 2-3 weeks, and tributyltin does break down to less toxic di- and monobutyl forms over time. These characteristics are important when comparing TBT to other long term toxic pesticides already banned or restricted, such as kepone, DDT and toxaphene. However, TBT's eventual degradation in the environment has little practical impact on its toxic effects, as the registered use and application of TBT contemplates a steady release of pesticide residues. These releases provide a constant resupply of tributyltin, the most toxic form, as long as a TBT-treated vessel remains in the water.

There can be and should be no doubt that TBT is a very toxic pesticide which can be concentrated in animal tissue. It exerts its toxicity in a variety of ways at levels in the low parts per trillion range, and the very nature of its registered use guarantees wide exposure for non-target species.

Alternatives

The manufacturers of TBT paint products have praised TBT paints for their effectiveness and the length of time protection persists. The Navy would have us believe that our national defense is imperiled without the paint. While there can be no doubt that an effective, long lasting marine antifoulant is both a military necessity and an economic boon, it does not necessarily follow that TBT is an essential part of the program.

The major technological breakthrough in marine antifoulant paints was not the use of TBT but the development of self-polishing copolymer paints (1). For the first time in history, paint formulations permitted the incorporation of a marine toxicant into the paint matrix, allowing control over the release rates of the active ingredient. Although TBT is an effective biocide to use in copolymer paint formulations, it is not the only copolymer paint additive available. Copper-based copolymers are commercially available, as well, and have been for several years.

In fact, some shipyards prefer the copper-based copolymer antifoulants. The Newport News Shipyard and Drydock Co., for example, has a standing policy against the use of TBT. In testimony under oath before the Virginia Department of Agriculture and Consumer Services, the shipyard's Manager of Environmental Engineering, Mr. Theodore Ray, stated that the shipyard refused to apply TBT and did not wish even to work with the product, usually requiring the paint to be removed at another site before the vessel would be accepted for maintenance or repair in the shipyard. Mr. Ray cited personal and professional experiences with TBT that led the shipyard to conclude that worker safety and environmental concerns did not permit the use of TBT by the shipyard, even if it resulted in loss of business (8). The Newport News Shipyard presently uses copper-based copolymers and believes them to be effective antifoulants. The company is also exploring the use of other "self-polishing" paints which have low surface tensions that cause developing marine growth to be sloughed off the paint's surface as the vessel travels through water. In summary, Mr. Ray stated, "We have trouble understanding the rationale of vessel owners who insist on the use of coatings having a high risk to the workers applying them and to the marine environment when other alternatives are available without those risks" (8).

That effective alternatives to TBT paints are presently available is born out by at least one major paint manufacturer, as well. Referring to the "pro tin" allegations that severe economic impact would occur to the U.S. Merchant fleet or to the Navy, or that the U.S. would lose ship building and repair business without the use of TBT, Mr. Bob Osmer, Vice President for Marketing of Devoe Marine Coating Co., testified before Virginia authorities that "[f]rom our perspective, these allegations are simply not true" (10). Mr. Osmer further stated that "technology does presently exist to maintain all of the benefits previously associated with TBT antifouling without utilizing TBT". Devoe has applied its TBT-free paint to over 50 U.S. Navy, military sealift command, U.S. Coast Guard and commercial vessels, ranging from tug boats to tankers and from submarines to aircraft carriers. After three years of experience, Devoe asserts that their tin-free paint performance "equals or exceeds the performance of the TBT containing antifouling copolymers without the health and environmental hazards associated with TBT."

Because copolymer paint formulations allow control over the rate at which the incorporated toxicant is released, one issue which will need to be addressed is the lowest effective release rate for TBT. Release rates of available TBT paints are not yet public knowledge, although they are on file with EPA as a result of the data call-in issued in conjunction with EPA's special review of TBT antifoulants under FIFRA. The release rates of different formulations appear to vary widely, and the lowest effective rate has not been determined although it may be quite low. EDF has learned that a substantial portion of the antifoulant paint line produced by Devoe Marine Coating Co. has release rates equal to or lower than 1.0 ug of TBT per square centimeter per day. Devoe contends that these paints have proven effective and durable during the 7-8 years they have been commercially available.

The availability of low-release and tin-free alternatives already in use, as well as the position and experience of the Newport News Shipyard, clearly undercuts bloated claims that the United States shipping industry cannot compete at home or internationally without TBT. Furthermore, claims about the economic advantages of TBT do not consider the cost of pollution control. Water quality criteria, expected from EPA in April 1987, are certain to be at low pptr levels. Even the Navy has recognized that the criteria may be as low as 50 pptr (9). This will almost certainly require extensive treatment of drydock wastewater in order for discharges to meet water quality standards. These treatment costs are already "plugged into" copper-based paints, as shipyards already have permit limits and treatment systems for copper applications. TBT, on the other hand, will require new wastewater treatment technology. Such potential treatment costs are considered poorly, if at all, in economic evaluations of TBT use.

Current economic evaluations of TBT antifoulants must be carefully reviewed. For example, the report submitted to Congress in January 1986 by the Naval Sea Systems Command, entitled Organotin Antifoulant Paint: U.S. Navy's Needs, Benefits and Ecological Research, appears to overstate the benefits of using TBT paints. Cost-saving and certain other comparative figures are derived by comparing TBT to conventional copper-based paints. This is a very questionable comparison, since conventional antifoulant formulations are an obsolete technology and would not likely be used by the Navy if TBT was unavailable. A more appropriate comparison is between TBT and copper-based copolymers, which seem to offer comparable effectiveness and term of protection. Even if these newer copper-based copolymers have less testing background than TBT, they are clearly as effective and probably more effective than conventional copper antifouling paints. Further, projected fuel savings in the 1986 report are unrealistically high in today's market, since oil prices have declined from $28.61 per barrel in 1984 (the period used in the report) to a current price of $17.51 per barrel (4). Because the price of fuel and the length of time protection is provided from fouling organisms are the dominant factors in the Navy's economic analysis, the Navy's 1986 report is already seriously flawed in its use of comparisons to conventional copper paints and in inflated fuel costs.

Similarly, the claims of economic disaster by commercial shipyards must be seriously questioned in light of the statements by Newport News Shipbuilding and Drydock Co., one of the country's largest shipyards. The Newport News Shipyard is not without direct competition. Only a few miles away, in the same harbor area, sits Norfolk Shipbuilding and Supply Company, an avid proponent of TBT. Although the Newport News Shipyard has lost some business to its Norfolk competitor, those losses have not been substantial enough to change their position on TBT's uses and dangers.

Effective alternative antifoulants to TBT are available. The only notable exception is for aluminum hull vessels, which cannot use copper-based antifoulants because of corrosive reactions in seawater. We recognize that copper is also toxic to marine life, but it is significantly less so than organotin compounds, and its impact on nontarget species is generally minimal.

Having considered the toxicity of TBT and the availability of alternatives, we come now to the question of TBT regulation. TBT was legally registered as a pesticide in 1953. Given what we now know about TBT's toxicity, it is doubtful that such registration could occur under today's law. The EPA's Office of Pesticide Programs is currently reviewing the status of TBT registration and has already initiated a data recall program. Unfortunately, any action to alter TBT registration under EPA's present administrative review requirements could take several years. EPA has been requested to act under the emergency provisions of FIFRA but has not done so to date.

This Congress, acting under an amendment to the military appropriations bill, effectively prohibited the Navy from using TBT paints this fiscal year. However, no other uses are affected.

Faced with the lack of decisive action from EPA and mounting evidence of serious environmental harm, several states have acted on their own. North Carolina adopted a water quality standard of 2 pptr in 1985. Virginia has banned the application of TBT paints to all vessels (excluding aluminum hulls) less than 25 meters (82 feet) in length and restricted the use of TBT paints by release rate for all other vessels. The Maryland legislature has passed similar legislation which now awaits signature by the Governor. Virginia and Maryland acted to protect the resources of the Chesapeake Bay from serious damage, inconveniencing their citizens with respect to other coastal states, because the evidence before the respective states was overwhelmingly against allowing continued TBT usage.

On the West Coast, Alaska, Washington, Oregon and California have banded together under the Pacific Fisheries Legislative Task Force to introduce legislation in each state to control TBT. All four states have bills at one stage or another in the legislative process. Many other coastal states are reviewing TBT use in one forum or another. All these individual states are trying desperately to protect their water quality.

Nor is the United States alone in its effort to control TBT-related damage. Japan, Canada, England, France, West Germany and Switzerland are considering, or have taken, regulatory action on TBT. The French have banned TBT application to vessels under 25 meters; after working with the TBT problem through public information and advisories, England has now decided to move to a water quality standard of 2 pptr.

Action by individual states cannot, however, do all that is required. Interstate competition in the shipbuilding and repair business is intense. It is extremely difficult for individual states to take any action which puts their individual shipyard industry at a disadvantage vis-a-vis neighboring states and competing industries. Thus, Virginia and Maryland can control "small boat" use of TBT but cannot exert the national market controls necessary to address major shipyard facilities. For the same reasons, it is difficult for individual states, without formal EPA criteria, to adopt water quality standards which are so crucial to the overall control of TBT. This results, for example, in Virginia's banning small boat use of TBT but failing to regulate the discharges of TBT from shipyards. Advocates of TBT use are quick to exploit these state weaknesses and can effectively block or dilute the potential impact of state regulations.

Individual states also cannot effectively respond to marketplace contamination by TBT. As was noted earlier, TBT is taken up and concentrated by marine fish and shellfish, and there is evidence that detectable levels of TBT are reaching consumers at the marketplace. We do not know whether consumption of TBT-tainted products is a danger or not. We can speculate conservatively, as we should with any toxic contaminant, that these levels are high enough to warrant concern and that food products should kept as free as possible from such contamination. Fear and concern for what could happen is reflected in a resolution passed by the Pacific Fisheries Legislative Task Force on November 16, 1986, calling for an immediate ban on all salmon imported into or produced in the United States in pens treated with TBT.

The bottom line is this: TBT registration as a pesticide in 1953 did not contemplate the tremendous surge in the use of the pesticide in antifoulant paints which occurs today, nor did the registration contemplate the continuous and heavy exposure of this product to nontarget species through normal use. Further, 1953 detection analysis was too crude to establish accurate toxicity levels. TBT use has now surpassed the reasonable bounds of tolerance in environmental evaluation and is a toxic poison whose uses must be curtailed until it can be used safely. The time has come for action by this Congress: action to bring uniformity and consistency to state actions, action to provide adequate water quality protection until EPA can complete its water quality and pesticide review process, and action to protect consumers from tainted foods in the marketplace.

EDF recommends the following steps:

1. Immediately ban the use of TBT by all vessels, including tugs and barges, under 25 meters in length. Only aluminum hull boats should be excepted.

This action is the only feasible way to address the rampant concentrations of TBT that occur in crowded marinas and harbor areas where smaller boats are moored. These areas, by virtue of their "safe harbor" characteristics, do not have sufficient tidal exchange or flushing to adequately dilute TBT to acceptable levels. Furthermore, because of TBT's high toxicity, removal of these concentrated sources of TBT is the only way water quality standards could be met in these areas.

2. Continue the current ban on Navy use of TBT until EPA can complete its water quality evaluation and propose both a water quality criteria and an "acceptable leach rate" for TBT marine paints compatible with the water quality criteria.

This action is essential to avoid two potential catastrophes. The Navy must not be permitted to "flood" congested harbor areas with a tremendous new and additional influx of TBT from a renewed fleet wide painting program before EPA can even determine the appropriate water quality criteria. Secondly, the Navy should not be permitted to spend taxpayer dollars to coat the fleet with a paint that may not, and probably will not, be compatible with EPA's approved leach rate. Because these paints last for five or more years and are cost-prohibitive to remove for paint treatment only, the Navy should not be allowed to proceed at this time with so many issues unresolved and with alternative tin-free paints available.

3. Strictly as an interim measure for all non-military vessels over 25 meters and any aluminum hull boats, establish the lowest minimum release rate for TBT paints that has been shown by existing use to be reasonably effective.

This action would allow continued use of TBT paints, provided the lowest release rate paints were employed. The release rate should be one which a commercially available paint has demonstrated is effective. It does not have to be the most effective paint, nor should it necessarily be a paint guaranteed to last five years or more. The 5.0 ug per square centimeter per day release rate recently set by Virginia, for example, is so high that it would apparently allow some free association paints to be used. Until EPA publishes its final acceptable release rate, we recommend that an interim release rate be chosen, using the data recall information being compiled by EPA, that is the lowest reasonably effective, commercially available release rate. Informal information indicates that EPA has received data from at least one manufacturer that has on the market antifoulant paints with leach rates from 1.0 to 3.0 ug per square centimeter per day. The bill should provide that this interim release rate becomes null and void upon publication of an acceptable release rate by EPA in the Federal Register.

4. Finally, to insure adequate review and protection of public health, specifically request that the Food and Drug Administration review TBT contamination of food in interstate commerce and promulgate tolerance limits for TBT formulations as appropriate.

Consumer interest and confidence in seafood, which is presently enjoying an increase in popularity, could be seriously affected if TBT residues come under question. The scientific literature has already reported that TBT formulations presently used in marine paints are immunotoxic, selectively affecting the thymus and immune protection system in rats; they have also been found to adversely affect human red blood cells (21,15,5). Review of these compounds from the viewpoint of public consumption is appropriate and warranted.

While tributyltin may be a very effective antifoulant paint additive, it is also a very toxic pesticide which is already having a serious and widespread impact on marine organisms. It has the potential to cause adverse human health effects through the consumption of contaminated food. There are alternatives to TBT in the new copper copolymer paints, and there is strong evidence that TBT would remain effective as an antifoulant if used in smaller amounts. Whatever science and technology may develop for us in this area in the future, TBT must be strictly regulated now.

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SUPPLEMENTAL COMMENTS OF THE
ENVIRONMENTAL DEFENSE FUND

SUBMITTED TO THE

SENATE SUBCOMMITTEE ON ENVIRONMENTAL PROTECTION

RE: TRIBUTYLTIN

The following additional comments by the Environmental Defense Fund (EDF) are filed in response to issues and questions raised at the hearing on tributyltin (TBT) which was held by the Subcommittee on Environmental Protection on April 29, 1987. EDF would appreciate the inclusion of these comments in the record for consideration by Subcommittee members.

Public Opinion on TBT Regulation

Some senators at the April hearing, particularly Senator Mikulski, were very interested how the public, as well as potential users of TBT, had responded to TBT restrictions by the states. Maryland was able to respond to the question immediately: Natural Resources Secretary Brown stated that no one objected at any hearing and that Maryland enjoyed the support of the marine trades and fishing industries. EDF staff attended the Virginia legislative hearings and participated in the legislation development process; we can state that no one appeared in opposition to the Virginia bill and that it passed the Virginia General Assembly unanimously.

More recently, two states have enacted laws more stringent than the Virginia and Maryland bills. Alaska recently banned the use of TBT on vessels under 4,000 gross tons and imposed a TBT maximum release rate of 3.0 ug/cm^2/day on all other vessels. According to Alaska officials, there was little opposition to the bill. The state of Washington has enacted a total ban on the use of TBT paints (except on aluminum hulls) until EPA promulgates standards for the use of TBT; the bill, which becomes effective in 1988, passed both the House and Senate of Washington unanimously.

Several other states have also recently acted to control TBT. Oregon passed legislation banning the use of TBT on boats under 25 meters in length, while Michigan's Department of Agriculture has summarily suspended the sale of TBT antifoulant paints and plans to hold formal hearings on June 23, 1987. (6) Texas officials recently discovered that many TBT paints were not registered in that state and ordered removal of those brands from the market. (20) Legislation to ban or restrict TBT is pending in California, Michigan and Maine; all three states are expected to act within the next 30-60 days.

In addition to individual states, numerous organizations oppose the use of TBT. Of these, the Pacific Fisheries Legislative Task Force has adopted a resolution seeking a Congressional ban on TBT use. (14) The American Farm Bureau Federation, a general farm organization representing 3.5 million family members, has urged that EPA "consider an immediate ban" on TBT use. (4) The Pacific Coast Federation of Fishermen's Associations, the West Coast's largest commercial fishermen's organization, has also called for a ban on TBT use. (13)

Judging by the activity in at least five coastal states, as well as by comments made by International Paint at the April 29 Subcommittee Hearing, it is unlikely that there will much opposition, if any, to national legislation that bans TBT's use on vessels under 25 meters and sets a low release rate for all other vessels. However, there is no assurance that these restrictions would fully protect aquatic life, and any release rate which is set should be as low as possible and related to EPA's water quality standard and release rate analyses.

In summary, several state actions have clearly indicated that the public desires effective TBT control and that legislation for such controls enjoys popular, if not unanimous, support. There is no debate concerning the availability of TBT substitutes for smaller boats; where debate has occurred, it has centered around the existence and availability of effective tin-free antifoulants for larger vessels.

Alternatives to TBT antifoulant paints

Any attempt to completely ban TBT's use would probably be opposed by the U.S. Navy and by certain paint manufacturers who allege they would lose international commercial vessel business. Opposition is based on an asserted lack of suitable substitutes for TBT which can protect against fouling organisms for the 4-6 year maintenance interval normally employed for large commercial and military vessels.

As a result of this asserted lack of substitutes, confusion seems to persist over whether or not effective alternatives to TBT paints are available for larger vessels. Devoe Marine Coatings, a large paint manufacturer, has repeatedly maintained that effective and enduring alternatives, in the form of the self-polishing tin-free ablative paints, are on the market and that they are being used by a variety of commercial and government ships, from Coast Guard vessels to aircraft carriers and tankers. Newport News Shipbuiding and Drydock Company, a major Virginia shipyard that builds and services commercial and military vessels, corroborates the availability and effectiveness of "tin-free copolymers," or the self-polishing ablative paints. Also, Newport News Shipbuilding has, for some years, refused to apply TBT paints or even to allow them into the shipyard on vessels scheduled for overhaul. (TBT paint residues are removed elsewhere before the vessel is brought into the dock for maintenance.) (9,15)

It seems to us that the confusion over the existence of suitable TBT substitutes continues because of (1) misleading assertions by International Paint Company that ablative paints are "old technology," physically mixing biocide into the paint matrix and thus failing to provide the kind of release rate control which is afforded by chemically binding the biocide, and (2) the fact that the terms "ablative" and "copolymer" are used interchangeably in the paint and paint-user industries, since the self-polishing ablative and self-polishing copolymer paints act in a similar way and seem to provide equivalent protection.

It is our impression that ablative paints span the old and new anti-foulant paint technologies, with some older ablative paints using physically mixed biocide which is exposed and released as semi-soluble paint binder is washed away. "State-of-the-art" ablative paints, however, chemically incorporate the biocide so that it is released by reaction with seawater, leaving behind a porous binder which becomes more soluble and then is washed away; these newer ablative paints also increasingly smooth, or self polish, the paint surface as a vessel moves through the water. Since these two advantages (chemically bound biocide and self polishing action) are the same ones afforded by copolymer paints, the paint and paint-user industries tend to use the terms "ablative" and "copolymer" interchangeably. For example, one large paint manufacturer, who sells both TBT self-polishing copolymer and copper self-polishing ablative paints, regularly receives orders for its "tin-free copolymers" and fills them with the ablative self-polishing paints. (11) International Paint itself has referred to the use of "non-tributyltin copolymer paint." (8)

When alternatives to TBT antifoulants are being considered, a distinction should be made between (a) paints which chemically incorporate the biocide and provide self-polishing action, and (b) paints which do not provide these advantages. Both self-polishing copolymer and self-polishing ablative paints provide the release rate control and long-term protection afforded by a chemically incorporated biocide; they also provide smoothing action--regardless of the biocide used and regardless of what the paint is called. Both paints are commercially available: self-polishing TBT copolymer and self-polishing TBT ablative paints have been on the market since the mid-1970's, while self-polishing copper ablative paints have been commercially available since 1983.

It should be pointed out that when advocates of tin-based antifoulants speak of the economic disaster which would befall the shipping industry if tin-based paints were banned, they compare costs and drydock requirements of TBT copolymer paints with costs and performance of older style, physically mixed copper paints. The comparison should, however, be between TBT copolymers and the self-polishing copper ablative paints, which offer an equivalent term of protection and effectiveness. Moreover, comparisons of TBT paints and any alternatives ought to examine pollution control costs and the expenses associated with minimizing the risk of environmental damage and occupational exposure; these factors, which frequently are not considered, increase the costs associated with use of TBT paints of any type.

In summary, there is substantial evidence that TBT copolymer paints and the self-polishing tin-free ablative antifoulant paints offer equivalent protection. The tin-free paints, which are commercially available from more than one manufacturer, offer an alternative to TBT that is both safer for the environment and economically competitive.

Environmental Effects

Proponents of TBT antifoulants have argued that TBT is not an environmental hazard. They have asserted that scientific data generated by reputable scientists all over the world is either technically flawed or applicable only in the laboratory and not in the "real world." They argue that if TBT is as toxic as everyone says, then actual environmental damage should be more apparent. In their view, the short half-life of TBT mitigates against any serious environmental impact; if any impact is occurring, it must be considerably less than what is predicted by laboratory tests. There was little response to these views at the Subcommittee hearing in April.

Environmental impacts have in fact been observed. In reviewing environmental impacts, however, it is important to recognize several points. First, TBT is an organic compound, and laboratory analysis of organic compounds is expensive and time-consuming. Second, TBT has reported toxicity at parts per trillion (pptr) concentrations. This is an extremely small amount of TBT, and only recently have analytical techniques been developed which can detect such minute concentrations. Most states did not have the methodology or equipment necessary to analyze for TBT until recently, and some still do not: the number of samples collected from the field for analysis is therefore very limited and in many states nonexistant. Third, laboratory analysis of soft tissue for TBT is even more demanding and expensive than analysis of water or sediment samples. Because of these factors, many states have no TBT data. Others are in the midst of costly sampling programs, many of which await funding. For example, there are as yet no funds available for crucial baseline sampling of shellfish in the Chesapeake Bay, even though informal sampling has revealed that oysters taken from various parts of the Bay already contain tissue concentrations of TBT at parts per million (ppm) levels. (10)

A fourth important point to remember about TBT is the insidious nature of its toxicity. TBT causes a number of different effects as well as variations in effect from species to species. Some effects may too subtle to be readily picked up by conventional measures of environmental impact. For example, laboratory tests have determined that TBT has a number of serious effects on reproduction, growth and development in shellfish. These effects, when widespread, could result in the die-back of the affected population; yet field measurement of reproductive success in oysters is extremely difficult, given the wide variety of factors which affect survival of oyster larvae. Similarly, the discovery of TBT-induced imposex (development of male sex organs in the female population) in shellfish required detailed studies on sex organ development in snails and on sex ratios in general populations in different areas, and then linking the effect to the environmental presence of TBT. Although such studies are tedious, costly and difficult to undertake, without them scientists might not understand TBT's effect on population dynamics until affected species become severely depleted.

Given these constraints, accurate data on environmental impacts of TBT will be developed slowly, and some effects may not be apparent until after serious impact has already occurred. Nonetheless, by interviewing many people who are now working on TBT, and putting together information from independent sources, EDF can report several documented instances of environmental impact for your review. It is, in our opinion, only the beginning of information on environmental damage which will be forthcoming in the future.

Gross Abnormalities in Oyster Development. The French first observed and accurately documented a growth abnormality called "balling" in oysters taken from Arcachon Bay, France. (2) In balling, or chambering, the affected oyster develops thick, chambered layers of shell which tend to grow dorso-ventrally rather than longitudinally, as is normal. The result is an oyster which has poor meat development and very thick shell, making the oyster unmarketable. This phenomenon was initially blamed on excessive siltation and other natural causes, but France has now clearly linked this effect to TBT and has been able to control it by reducing TBT levels in French waters. (1) The same effect has been reproduced in laboratory experiments in France (3), and also by California researchers using oysters from the Pacific Coast of the United States. (22)

Chambering has now also been documented in oysters and mussels taken from U.S. waters. In 1986, California officials took unaffected oysters from clean water and transplanted them into known areas of TBT contamination in San Diego Bay; the result was chambering and reduced growth. (21) More balling, or chambering, was confirmed in commercial oyster grounds of Morro Bay (California) in June 1987. (22) California officials have also examined oyster shells from commercial oyster grounds in Coos Bay (Oregon) and confirmed chambered shell development attributed to TBT (22); this finding is discussed in more detail later. No photographs of oysters from U.S. waters are available at this time; however, a cross-section of an oyster from contaminated waters in Portugal clearly demonstrates the chambering effect and resultant reduced meat cavity (Photo 1). The extreme chambering seen in Photo 1 is representative of the most seriously affected oysters at all three West Coast sites. (22)

Field observations have also been made of balling in mussels transplanted to U.S. waters known to be contaminated with TBT. In the 1986 California study referred to above, mussels from clean waters were transplanted to locations along a gradient of known elevated TBT concentrations in San Diego Bay. After a little over four and a half months' exposure to TBT seawater concentrations of approximately 0.3 parts per billion (ppb), the mussels (M. edulis) showed a marked reduction in growth and also the decreased length/thickness ratio which characterizes chambering, or balling, in the Pacific oyster. (21) A second type of mussel, M. califorianus, which was transplanted with the M. edulis did not show signs of chambering but did show significantly reduced growth upon exposure to TBT in concentrations less than 0.23-0.93 ppb; at 0.23-0.93 ppb, there was no growth at all. (21)

It should also be noted that in California's transplant test, state scientists found chambering in oysters placed in "control areas," or areas thought to have too little TBT present to produce an effect. Of three water samples taken to monitor for TBT in the control areas, the highest TBT value obtained was 25 pptr. Concentrations presumably at this level and lower produced chambering. Subcommittee members may recall that EPA officials indicated at the April hearing that they would be issuing an "advisory" on TBT this summer, with a warning about saltwater TBT levels above an average concentration of 35 pptr.

A recent field experiment in France produced a remarkable result. In essence reversing the California test, French scientists transplanted chambered oysters from TBT-contaminated waters into clean water. Although these oysters had already developed chambering, they resumed normal growth when transferred to clean water. (1) This is dramatically demonstrated in Photo 2, where the first four inches of oyster growth show extensive chambering, while the last two inches of growth (in clean water) show a more typical flattened oyster profile.

The chambering in the Pacific oyster provides scientists and laymen alike with a distinctive and readily visible sign of TBT damage. Because this effect is limited to Pacific oyster species, however, determining what is happening to the East Coast oyster industry will be more difficult--although the lack of any obvious growth abnormality in the Atlantic species should not be interpreted as lack of effect. Using the growth abnormality of chambering, California scientists have clearly demonstrated damage to shellfish in their state's waters--and they have found damage not just in heavily-contaminated areas but also in waters thought to be relatively free of TBT.

Loss of Commercial Oyster Grounds. Operating in waters of Coos Bay, Oregon, which have comprised traditional oyster grounds since the 1940's, Mr. Larry Qualmann of Oyster Enterprizes has seen the effects of TBT. Working in commercial oyster grounds about one mile from the nearest marina, Oyster Enterprizes considered these oyster grounds very profitable until about 10 years ago. Since that time, oysters from this area have grown at an increasingly slower rate; their shells become thick and are described as being "baseball size." Where these oysters in the past reached market size in 2-3 years, it has been taking five years. The effort and cost of producing oysters that require five years to reach market size was too expensive to maintain; moreover, the half-shell market for these oysters was lost because buyers and consumers would not accept the "mutated" shell: Oyster Enterprizes has now abandoned the grounds to work areas 2-3 miles further out, where the oysters grow better. (15)

Oyster shell sent to California scientists from the Qualmann grounds have confirmed what Oregon officials expected: the balling effect was caused by TBT and is the same chambering shown by contaminated oysters in California and France. (22) Oregon officials are now preparing for a comprehensive study of TBT levels in their waters in order to determine what other areas have been impacted. They and Mr. Qualmann believe that other areas are affected but have not been reported because they still produce some oysters.

The Oyster Enterprizes experience is essentially the same scenario played out in French waters over the past decade. Reductions in oyster growth reduce commercial productivity, the shells thicken, mortality increases, and eventually the oysters become unmarketable because of poor meat development and shell balling. The grounds are then abandoned.

One final note on this subject: Coos Bay is part of the National Estuary System, which sets aside and preserves some of the nation's most important estuarine areas for research and study of natural ecosystems.

Deformities, Defects and Mutations. One of TBT's more disturbing traits is the compound's ability to cause a variety of different deformities in organisms at concentrations well below acutely toxic levels. These effects are documented in the literature and have been discussed in other reports. They include defective regeneration of claws and legs in fiddler crabs (25); body bifurcation and subsequent death in marine worms (24); imposex in whelks (5), snails (19) and shellfish (23); and loss of eyes or development of extra eyes in marine snails (5). Imposex linked to water concentrations of TBT has been observed in the field in both the U.S. and Europe (5,23,19), and California officials have now found deformed or mutated marine snails in Monterey Harbor. (22)

Monterey Bay, located north of Big Sur National Seashore, is home to a wide variety of aquatic life and is a favorite site for seasonal observation of many sea mammals, including whales, sea lions and sea otters. It is also home to a sizable marina and TBT. Aware that water samples established the existence in Monterey Harbor of TBT concentrations well in excess of those known to produce three-eyed snails in the laboratory, California scientists began looking for this deformity in the harbor. Snails with a fully formed third eye were found. (22) Magnified several times with the shell retracted, the third eyestalk is plainly evident in Photo 3.

These field findings simply documents what laboratory experiments have repeatedly shown--that TBT is a very toxic compound, capable of causing widely varying defects, deformities or mutations in marine organisms. Although shell balling in the Pacific oyster forced itself on our attention, many of TBT's toxic effects are less visible; they also occur in species which are not commercially harvested and thus escape regular scrutiny. Many of TBT's toxic effects have yet to be documented in the natural environment simply because research money and time have not been available to look for them. For organisms which do not demonstrate an obvious defect, it is likely that many individuals in a population will simply die or suffer reduced functioning because of internal defects and abnormalities. Although developmental defects do occur rarely and randomly in nature, any pollutant which produces them should be viewed with the utmost caution: it is, truly, a potent environmental poison.

Accumlation and Contamination in Tissue. Laboratory experiments with bioconcentration have shown that TBT accumulates to substantial levels in the tissues of a variety of animal species. Field observations are now confirming environmental accumulation of TBT in tissues of such animals as shellfish, finfish, and sea otters. It is important to note that some of the tissue showing TBT contamination is from seafood purchased off market shelves.

Navy studies have documented accumulation of TBT in Virginia oysters taken from the Elizabeth River, which has heavy commercial and Naval ship traffic; these oysters contained almost 4 parts per million (ppm) dry weight. (7) Informal sampling performed by the Virginia Institute of Marine Science (VIMS) has confirmed TBT tissue concentrations up to 1.5 ppm in oysters from various Virginia marina areas. (10) VIMS has also found TBT concentrations of about 10-20 parts per billion (ppb) in the tissue of market-purchased oysters from the Rappahanock River, which is relatively free of ship activity and is considered to have clean water. (10)

An Alaska study looked at mussels taken from various points along the Pacific coast from San Diego to Kodiak (Alaska); TBT tissue concentrations were found in parts per million levels. (18) Of particular interest were mussels taken from Auke Bay, Alaska, which has 18-foot tides and only a single marina at one end of the Bay as a known source of TBT contamination of the waters. Even under these dilution and tidal flushing conditions, mussels up to five miles away from this marina had measureable levels of TBT in their tissues. (18)

Tissue concentrations of TBT have also been found in various types of salmon. Chinook, silver and Atlantic salmon obtained from marketplaces in Seattle (Washington) and Portland (Oregon) contained concentrations of approximately 59 to 200 ppb. (17) Blackmouth salmon caught in Puget Sound (Washington State) have been found to contain up to 300 ppb TBT in their tissues, although more typical levels for these salmon were in the low parts per billion. (26)

EDF has corresponded with many states on both U.S. coasts and found that due to analytical difficulties, costs and the relatively recent concern about TBT, most states have little idea how much TBT contamination may be present in their fish or shellfish. For example, Virginia, which has generally taken the lead nationally on TBT research and regulation, has yet to begin any comprehensive sampling program for TBT in fish or shellfish.

Although it is well documented that TBT concentrates in fish and shellfish tissue, there has not been documentation, until recently, of TBT bioconcentration further up the food chain. In 1987, California state officials analyzed livers and kidneys of sea otters from Monterey Bay (the sea otter is an endangered species attempting a comeback on the West Coast). These organs contained TBT in the parts per million range. (22) As of this writing, California authorities are awaiting confirmation of these tissue levels from labs in France; however, the findings have been produced by two different analytical methods in California and are believed to be correct. (22)

If confirmed as expected, this finding is very important. First, it demonstrates that TBT residues accumulate in mammalian tissue. Secondly, the otters probably received TBT solely from contaminated food, as other routes of uptake are unlikely in this mammal. The otters' diet consists of shellfish, crabs and other invertebrates which have been shown to accumulate tissue burdens of TBT.

Conclusion

Tributyltin is a serious environmental pollutant. Its effects are beginning to be observed and documented in the United States, and restriction of its use is now essential to protect our marine resources. There is substantial evidence that effective alternatives to TBT paints are available. While states have begun to act on their own to limit use of tributyltin paints, federal legislation is necessary to provide uniform and effective national controls and national protection.

Respectfully submitted,

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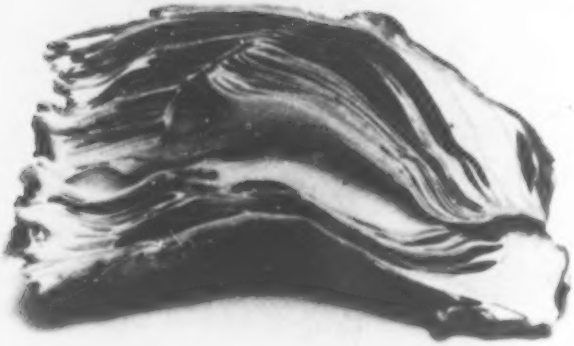

Photo 1. Cross-section of *Crassostrea angulata*, from Portugal. (Courtesy Mark Stephenson, California Department of Fish and Game, 1987.)

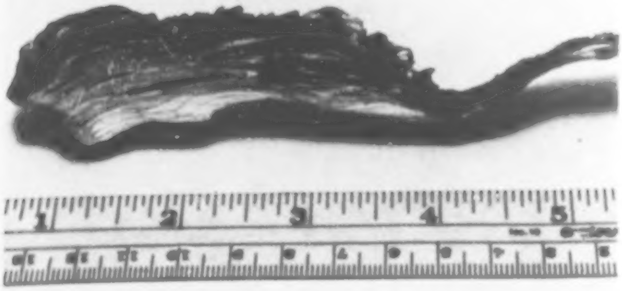

Photo 2. Cross-section of *Crassostrea gigas*, from France. Initial four inches of growth occurred in TBT-contaminated water; the remaining one and one-half inches of growth, the most recent, occurred after transfer to TBT-free water. (Courtesy Mark Stephenson, California Department of Fish and Game, 1987.)

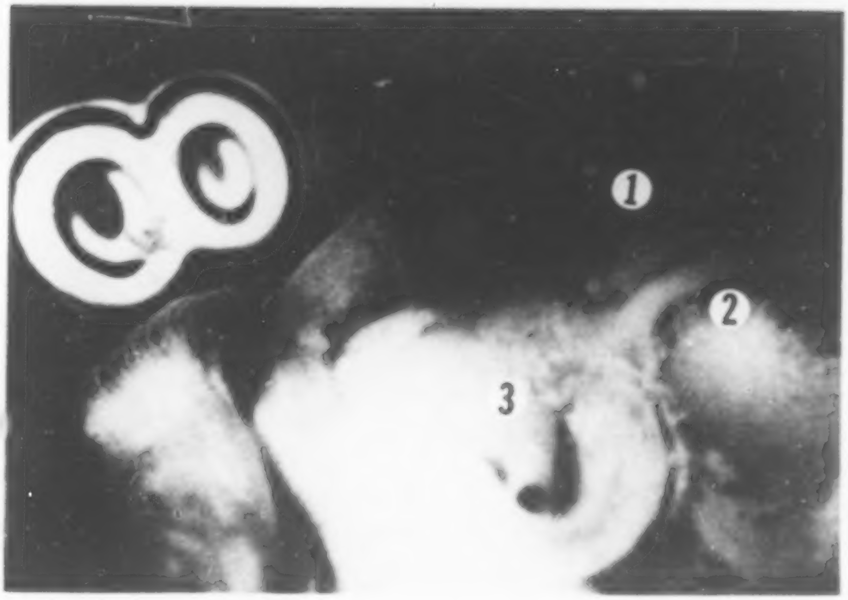

Photo 3. Marine snail, *Acanthina*, from Monterey Bay, California. Note three eye stalks (two eye stalks are normal). (Photo by Jan Dirks. Courtesy Mark Stephenson, California Department of Fish and Game. 1987.)

NORSHIPCO

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GEORGE H. CURTIS, III
Vice President

April 28, 1987

The Honorable George J. Mitchell
Chairman Subcommittee on
Environmental Protection
Committee on Environment and Public Works
Washington, DC 20510-6175

Dear Senator Mitchell:

On behalf of the 3400 men and women of NORSHIPCO, I thank you for the opportunity to present our position on the often times highly emotional issue of tribulyltin antifouling. We have been applying TBT antifouling for eight (8) years. This is not in disregard of human health and the environment.

In the time we have been using this highly effective but toxic antifouling we have had four (4) cases of dermatitis attributable to the paint. Our medical records indicate that we average nine (9) to ten (10) cases each year from other causes.

Further, as an indication of our caring for our employees is our lost time record. The National shipyard average is approximately 13.5 and our lost time record last year was 1.78. We probably have the best record of any shipyard in the United States. We do care and feel confident that with proper protection the application and removal of TBT can be accomplished without harm to human health.

As to the environment, we have not observed any detrimental effects around the shipyard. We did, however, impose certain restrictions on our applications several years prior to the restrictions now in effect in the Commonwealth of Virginia. These were:

1. We would not apply any TBT except those in a copolymer matrix.
2. We would not apply any antifouling that had more than 12% tin.
3. We did not apply TBT antifouling on any of our tugs, yachts or other small boats.

NORSHIPCO

April 28, 1987
The Honorable George J. Mitchell
Committee on Environment and Public Works
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We did, and still, support the legislation passed by the Virginia General Assembly. In our judgment this will adequately protect the environment until EPA can complete their studies. At the same time it will not do serious economic harm to the ship repair industry.

It is true that 60 - 70 percent of all ocean going merchant vessels have some form of TBT antifouling. It is also true that this percentage will increase and, because of the effectiveness and economic advantages, these ships will be painted, if not in the United States, elsewhere. A total ban would result in a loss of 80 percent of our commercial business, resulting is an substantial reduction in our work force.

We respectfully recommend legislation much the same as adopted by Virginia.

Again, thank you for the opportunity to present our views.

Sincerely,

NORFOLK SHIPBUILDING & DRYDOCK CORPORATION

George H. Curtis, III
Vice President